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Review of the Fossil Fauna of the Desert Region of Oregon, with a Description of additional Material collected there.

By R. W. Shufeldt.

AUTHOR'S EDITION, extracted from BULLETIN

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(*Continued from 3rd page of cover.*)

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Article VI.—REVIEW OF THE FOSSIL FAUNA OF THE DESERT REGION OF OREGON, WITH A DESCRIPTION OF ADDITIONAL MATERIAL COLLECTED THERE.

By R. W. Shufeldt.

Plates IX to XLIII.

Early in August, 1912, there was placed in my hands by the Department of Vertebrate Palæontology of the United States National Museum, for identification and description, a small collection of vertebrate fossils collected by J. C. Russell (season of 1882) and W. Day (season of 1883) of the United States Geological Survey, at Christmas Lake, Oregon (near Button's Ranch).

A superficial examination of this material convinced me of the fact that it was of sufficient importance for detailed description and illustration; but to properly fulfill such a task, it would be necessary to have before me for comparison, not only all the material upon which a previous paper of mine on this subject was based,[1] but, in addition thereto, all the skeletons possible of such American forms of the vertebrata as are now found in this Oregon Desert Region, as well as any other material of the kind, either vertebrate or invertebrate, which, in any way, might assist in the matter of identification or otherwise illumine the subject. Both of these requirements have been fulfilled, as far as possible, to the extent of the demand.

In this connection I am indebted to Mr. Charles W. Gilmore, of the Department of Vertebrate Palæontology of the United States National Museum, for transmitting me the above material of the Department for description and a preliminary examination of the mammal fossils. I have especially to thank Mr. J. W. Gidley, the curator in charge of the mammals and fish of the same Department, for his several examinations of the fossils of the mammals and some other forms described in the present paper; for his references of the different species, and for other courtesies and assistance upon many occasions in connection with this work while in the course of preparation.

Further, I am very much indebted to Dr. F. A. Lucas, Director of the

[1] Shufeldt, R. W. A Study of the Fossil Avifauna of the Equus Beds of the Oregon Desert. Jour. Acad. Nat. Sci. Phila., Vol. IX, Pls. XV–XVII, Phila., Oct., 1892, pp. 389–425.

See also abstract of this paper which preceded it in 'American Naturalist' (Vol. XXV, No. 297, Sept., 1891, pp. 818–821; and 'The Auk' (Vol. VIII. No. 4. N. Y., Oct. 1891, pp. 365–368).

American Museum of Natural History of New York City, for his approving of my request for the use of all the material upon which my previous publications were based, collected by Cope and Condon in the Desert Region of Oregon, and particularly to Doctors E. O. Hovey and W. D. Matthew of the Palæontological Department of that institution for their favorable recommendations and trouble in directing the shipment of the aforesaid valuable fossils to me from their museum to my home in Washington, and for other favors.

I am also in this connection greatly indebted to the United States National Museum for the unlimited use of the collection of skeletons of birds of that institution, and in particular to Dr. Chas. W. Richmond of the Department of Birds and his assistant, Mr. J. H. Riley, for the most valuable assistance in the matter in hand, as well as to Mr. Paul Bartsch, of the Division of Mollusks, U. S. National Museum, for his having identified specimens of shells from the Cope collection of these Oregon fossils belonging to the American Museum.

There were two of these specimens,— one each of *Carinifex newberryi* and *Sphærium transversum*, both from Fossil Lake. As there were no other shells, and as these are still abundant in the existing fauna of the region, it will not be necessary to mention them again in the present connection.

To Mr. Barton A. Bean, in charge of the Department of Fishes at the U. S. National Museum, I am indebted for assistance in connection with my examination of existing fishes in the collections of that institution, for comparison with such fossils of those forms as were discovered in the Oregon desert region, fragments of the bones of which were found among the specimens of the collections referred to above. These will be commented upon further on in the present paper. For the identifications of all the bones and fragments of bones figured in the Plates, I am wholly responsible.

At the present writing, then, I have before me a small collection of fossils from the U. S. National Museum; all the material of the Cope and Condon collections previously described by me, and the skeletons of many existing vertebrata found in the collections of the U. S. National Museum.

The character and number of fossils in the collection from the American Museum have already been described in my Academy memoir. As far as birds are concerned, it is altogether the largest amount of material representing Pleistocene birds in this country. The lot recently turned over to me by the U. S. National Museum — coming, as it does, from nearly the same locality — contains fossils resembling them in all particulars. Unfortunately, however, they are few in number and very fragmentary, though none the less interesting and important. Most of them are fossil bones of birds, while the rest are of mammals and fish; and, in most instances, the

specimens of any of the groups are represented in the Cope and Condon collection by a far greater number and variety; so, practically, they will be discussed in connection with them.

The U. S. National Museum Collection.

This collection I have illustrated by means of Plates IX and X, the first containing figures 1 to 16, and the latter figures 17 to 35.

At the time I first examined Professor Cope's collection, which, as stated above, constitutes the material to be reëxamined further on in this paper, it having come into the possession of the American Museum of Natural History, I met with fragments of bones in it, which led me to believe that they belonged to the well-known Sage Cock (*Centrocercus urophasianus*) of the Western Plains. This suspicion was confirmed after a moment's inspection of the fossils handed over to me by the Palæontological Department of the U. S. National Museum; for it contained a number of fossil bones of *Centrocercus*, several of which were quite perfect, and may all easily have belonged to the same bird (see Figs. 1, 4, 6, 7, 11, 12 and 13, Plate IX); while another belonged to a larger individual, and probably to an old male. (Fig. 9, Plate IX.) These will be more fully described further on in this paper, when I take up all the fossil material representing this species of grouse.

As stated in my Philadelphia Academy memoir, the Snow Goose (*Chen hyperboreus*) was an abundant species on the Pleistocene Lakes of Oregon, and its fossil remains are abundant in this collection (p. 409). Various fossil bones, representing this species, are figured on Plate XVI, and there is a more or less perfect head of a *humerus* of this goose in the collection belonging to the U. S. National Museum (Fig. 2, Plate IX). This collection also contains fragmentary remains of two other anserine forms, namely the Condon's extinct goose (*Anser condoni*) (Fig. 3, Plate IX), and the *Anser hypsibatus* of Cope,— another extinct species. These two geese will be touched upon more fully further on in this paper (Plate I, Figs. 3 and 5).

Grebes, of at least three genera, flourished on these Pleistocene Lakes of Oregon, and they are critically considered in their proper place beyond. Fossil bones of some of the species are present in the material belonging to the National Museum, (see Figs. 8, 10, 14, 15 of Plate IX, and Figs. 32–35 of Plate X), and the descriptions of these will be incorporated with others on another page.

Very recently, the U. S. National Museum has had added to its collections a fine skeleton (No. 223756) of the Harlequin Duck (*Histrionicus*

histrionicus), and this has been loaned me for my work in the present contribution. Twenty years ago, when I first examined this collection, a skeleton of this species was not at hand; and consequently, as in so many other instances, I could not state positively with respect to some of the anserine fossils I examined. That there are bones which belonged to Harlequin Ducks in the collection, however, can now be announced with certainty. Even in this small collection belonging to the Smithsonian Institution, there is a left coracoid of *Histrionicus*, and I show it in Fig. 16 of Plate IX. It corresponds exactly with that bone as we find it in the shoulder girdle of this species of duck as it occurs at the present day. (See Plate XXX, Figs. 360–363.)

There are a few fossil bones of fish in this collection, especially vertebræ and palatine bones (Plate X, Figs. 17–21, and Fig. 23). Up to the present time, I have not been able to refer these, or to name them, if belonging to extinct species. This, too, is a matter I shall touch upon later on in this paper, as a far greater number of these bones are to be found in the collection belonging to the American Museum. This also applies to the few mammal bones we find here, which, as may be seen by referring to Plate X (Figs. 24–31), chiefly belonged to representatives of the *Canidæ* and large hares of the genus *Lepus*. In my Philadelphia Academy memoir I refer, to some extent, to the mammalian fauna of these ancient lakes, and further on in the present contribution, the subject will be completed, in so far as my studies have carried me.

Further Studies of the Cope and Condon Collections, now comprising a part of the Palæontological Collections of the American Museum of Natural History.

PISCES.

As will be noted, under the figures of Plate XI at the close of this memoir, very little could be accomplished with respect to the fossil bones of such fishes as were collected at Silver and Fossil Lakes. There were not many brought back by the several collectors, and such material as there is, is fragmentary and broken up.

Cope pointed out, as I state in my Philadelphia Academy paper, that there were but *two* fishes represented, namely: *Salmo purpuratus* and *Mylocucus formosus*, the latter now being known as *Rutilus symmetricus* (Baird and Girard); and both of these are found in the existing ichthyfauna. Many of the bits of fossil fish bones were sufficiently perfect for me to name

the bone in any case — if not the fish to which it belonged. This I invariably did, as will be appreciated by a study of Plate XI. Personally I am of the opinion that there were, in Pleistocene time, a good many more species of fish in those lakes than the two above named ones, as the fossils seem to indicate this. I compared some of the vertebræ, opercular bones and others with such skeletal material as I had at hand, but was unable to arrive at any definite conclusions with respect to references. We very much need, at the National Museum, a good working collection of fish skeletons for the use of students. Unfortunately, there is no such collection, and a large part of what there is in that line is worthless.

Among the fossils now under consideration, there were found a number of peculiar spine-like bones which could not be, and have not up to this writing been, identified. At first I took them to be the weapon-spines found in the pectoral fins of most cat-fishes,— a view I promptly abandoned. Three of these spines are figured on Plate XI (Figs. 40–42); they vary somewhat in form and size; are *asymmetrical*, and do not possess, at their articular ends, the complicated joint of the large pectoral-fin spines of certain *Nematognathi*. These have likewise been examined by Mr. Gidley, Barton Bean and William Palmer, and none of these authorities were able to place them. Pectoral-fin spines of other species of fishes were found fossil in this collection, however, as may be seen by a study of Plate XI.

There appear to be no fossils in the collection to represent any of the vertebrate Classes or Orders between Fishes and Birds,— no Reptilia of any kind; Batrachians or allied groups. This is not surprising; for I have already pointed out in my previous work that the "Batrachians also are rare, but one species has thus far been taken in the region, and that a tree-frog (*Hyla regilla*). It is abundant on the shores of Silver Lake, though it does not resort to the timber. But two lizards have thus far been reported, namely: *Uta stansburiana* and a variety of *Sceloporus undulatus*. The latter is frequently seen sunning itself on the bare volcanic rock of the lake-shores. Only two snakes occur in this arid region,— the rattle-snake, known as *Crotalus confluentus leconti* and *Eutænia sirtalis parietalis*." (p. 391). Some of these forms are now, I believe, known under different scientific names, owing to the many nomenclatural changes which have taken place during recent years. On account of their small size and perishable nature, it is not surprising that the collectors failed to find the fossil bones of such animals as hylas, swifts, or even rattle-snakes. Some very small mammal and bird bones were found, however, as will be seen by referring to Figs. 66 and 536 on the Plates.

AVES.

Pygopodes.

Various species of Grebes, belonging to several genera, were among the most abundant bird-forms inhabiting the ancient lakes of Oregon. Considerable attention was devoted to these in my Philadelphia Academy memoir; and, at the time that this appeared, I was satisfied there were at least five pygopodine species, represented in the collection by an abundant lot of various fossil bones. These were *Æchmophorus occidentalis, Colymbus holbœlli;* possibly — and very probably — *C. auritus; C. n. californicus,* and *Podilymbus podiceps.*

Since then, *Colymbus auritus* has been established beyond all doubt, in as much as a skeleton of that bird has been added to the collections of the U. S. National Museum (No. 17273) since my first examinations were made (Plate XXXVIII, Figs. 441, 448). This was the principal trouble at the time I prepared my paper for the Philadelphia Academy: there were so few skeletons of existing birds available; and, indeed, at this writing, the grebes in the U. S. National Museum are very poorly represented. Strange as it may seem, that great national institution has not in its collections, at the present time (Nov. 13, 1912) any part of a skeleton of the existing Western Grebe (*Æchmophorus occidentalis*). Up to this date, I have had to depend upon the long bones of the limbs of a specimen of this bird, which was prepared by Professor Cope and myself,— someone having collected the specimen for him.

In general it may be said that there are several considerations we must ever have in mind, when we come to study, identify and *refer* the fossil bones of birds, and it is doubtless true of all animals; I mean the considerations of *sex,* of *age,* and of *time.* This is particularly essential with respect to the American species of Grebes, for the reason that the characters of the bones are wonderfully similar, and the correct ascertaining of the species is made the more difficult, not only for this reason, but for the fact that, in one or two instances, the species — as in the case of *Æchmophorus occidentalis* and *Colymbus holbœlli* — are so much of a size.

If, when the sexes of any particular species become fully adult, they agree with respect to *size,* that simplifies matters very much; but if, on the other hand, the female for example is markedly smaller than the male — both being adult — then a factor for comparison is at once introduced into our work. Still more difficult do correct references become when the bones are all mixed up, and there are present those of another species of only slightly smaller proportions, in which species the sexes — when adult —

again differ with respect to size. For example, the *tarso-metatarsus* of an adult *female Æchmophorus occidentalis* — the general characters being almost indistinguishable — might be, in all particulars, quite like the *tarso-metatarsus* of an adult *male Colymbus holbœlli*. In other words, there would be no doubt whatever about picking out the bones belonging to the adult *males* of the Western Grebe; but we would be confronted with an entirely different proposition, when we came to distinguish between the *female* Western Grebes and the *male* Holbœll's Grebes. And so on, too, for other species.

This is not all, however; for here comes in the second consideration,— that of *age*. Grebes, as in the case of many other kinds of birds, do not attain their full growth for several years; and about the second or third year, the long bones of the skeleton, for example, are not as large or as long as in the adult, while at the same time they are indistinguishable in other respects. Therefore, as another difficulty to contend with, we may, for example, mistake the *tarso-metatarsus* of a *subadult male Æchmophorus occidentalis* for an *adult male Colymbus holbœlli;* or, as may be readily appreciated, they may also be confused in other respects,— that is in regard to these two species of Grebes.

Finally comes in our *third* consideration, and that is the matter of *time*. These bones of our fossil grebes are many thousand years old. It is quite possible that either *Æchmophorus occidentalis* of *Colymbus holbœlli* became larger or smaller between the Pleistocene period and the present time; that is to say, the Pleistocene Western Grebe, for example, may have been either a bigger or a smaller species than the race now in existence, which descended directly from the former. This also applies to Holbœll's Grebe and others. For instance, if the Western Grebe were a *smaller* bird in Pleistocene time — and in this day we find a series of *tarso-metatarsi*, for example, representing it — *the characters being the same*, it would be difficult to distinguish the *tarso-metatarsus* of an adult *male* Western Grebe of the fossil form, from the same bone of an adult *female* of the *existing* race; while the *tarso-metatarsus* of an adult *male* of the existing race would be *larger* and longer than the corresponding bone in fossil individuals of that species, for the reason that the species itself became *larger* as it descended by generations from the Pleistocene time.

From my studies of this material, I am of the opinion that, with respect to size, *Æchmophorus occidentalis* and *Colymbus holbœlli*, of the Oregon Desert Region of Pleistocene, were no bigger or no smaller than their respective existing descendants of the present day. In other words, they are about the same, respectively, in the matter of proportions. This, then, does away with any difficulty arising in the matter of *time;* but it does not

do away with the questions of *sex* and *age*,— the characters being practically the same; we can still be led into error for the reasons I have pointed out above. Everything else being equal, we are often assisted in making a correct reference — with respect to these Grebes as well as in the case of other birds — when the point hinges on the question of *age;* but this only applies to fossils of the kind now being considered. I refer to the bones in fully adult species which are very *smooth, black* and *shiny*. In younger birds they are, according to their youngness, slightly *rough, gray* and *dull*. Of course in much younger specimens this is better marked, and we then have the condition of the epiphyses of the long bones to assist us. These may be coössified with the shaft in a particular case, or in "chicks" they may have dropped off and been lost altogether. These points are all very important, and must be borne well in mind when describing such fossils as the ones now being considered.

There is another point to remember in considering the fossil long bones of *Æchmophorus occidentalis*. I said in regard to it, in my Philadelphia Academy paper "Within certain limits, the long bones vary somewhat in length, but the majority of the specimens are typical. I found no humerus quite as large as that bone in the existing species; but there are not so very many examples of it in the collection, and probably no larger ones were secured. In the fossil bird, too, the distal margin of the ulnar crest — or that border bounding the fossa wherein the pneumatic foramina are found in other birds possessing pneumatic humeri — is rather fuller than it is in the humerus of the existing species. This very slight difference appears to be constant." (p. 396).

Now, although I said in that paper, in the next paragraph, with respect to *Colymbus holbœlli*, that it was found to be quite abundantly represented "by its fossil remains, it appears to be identical with the existing species bearing that name. It is a notably smaller species than *Æ. occidentalis*, and its fossil remains are easily distinguished from it." (*loc. cit.*, p. 396). At this date, I may say that in making those references, in the case of the two grebes in question, *size* alone was considered, and the important items of *sex* and *age* ignored. So it would be quite possible for one to mistake any of the principal long bones of the limbs of the *female Æ. occidentalis* for a *male C. holbœlli*, both being adult, and everything else being equal. I have no skeleton of *Colymbus holbœlli* at hand.

Ornithological authorities seem to find no differences in the lengths of adult male and female grebes of any of our North American species. In the case of *Æchmophorus occidentalis*, the *length* is usually given as 24 to 29 inches; the now not recognized Clark's Grebe (*Æch. clarkii*) 22 inches. *Colymbus holbœlli* 18 to 20 and a half inches; *C. auritus* 12.5 to 15.25 inches and *C. nigricollis californicus* 9 to 10.5 inches.

To some extent this may simplify matters, with respect to making correct references, in the case of fossil long bones of grebes; while, on the other hand, the marked variations in these bones themselves render such references very puzzling.

Among birds, turkeys (Meleagridæ) are good examples of these great differences in the lengths of the long bones due to age, sex, and other conditions. This fact I have already pointed out in another connection.[1]

There are, in this collection, several hundred fossil bones of the larger species of Grebes. In their general characters, the majority of these bones agree very closely with the corresponding ones in such a form as *Æchmophorus occidentalis*, and only slight departures are seen in others. Some idea may be gained of their number, when I state that I find more than seventy *coracoids* of the larger species of grebes, and over fifty *femora*. There are no skulls beyond a few fragmentary pieces, and a few portions of *mandibles*. There are over fifty pieces representing the *sacrums* and the coössified *dorsal vertebræ* of these grebes. Only the anterior parts of a few *sternums* are present; some *cervical vertebræ; scapulæ;* many long bones of the limbs, and so on.

Figs. 68 to 90 inclusive of Plate XII of this paper, give a very good idea of the proportional variations in size of these grebes' coracoids. Such bones as are figured in Figs. 70, 71, 73, 80, and others, are, without any doubt whatever, from *Æchmophorus occidentalis* (fossil); but in such cases as Figs. 76, 79, 88, 89 and 90, we have quite a different question presented us. All these latter are too short and small for old, adult, male specimens of *Æchmophorus occidentalis;* but any one of them may belong to females or subadults of either sex of that species, and we would have no way of determining the point with certainty in any case. This for the reason that there were several species of grebes on those ancient lakes of Oregon, and we find the fossil bones of all of them in this collection. So that such a grebe's coracoid, as is shown in Figs. 79 or 88 for example, may have belonged to a specimen of Holbœll's Grebe (*Colymbus holbœlli*) *or to some other species.*

As stated above, I did not find any *humerus* of these larger grebes — and of *Æchmophorus occidentalis* in particular — that had attained quite the size of that bone of any existing species to which it may have belonged. This is well shown in the case of the Western Grebe (*Æ. occidentalis*) in Plate XIII. Fig. 91 gives the *humerus* of the last-named bird, from a specimen prepared by Cope and myself. It will be noted that it is longer than any other humerus on the Plate, and I may say in the collection. The

[1] Shufeldt, R. W. On Fossil Bird-Bones Obtained by Expeditions of the University of Pennsylvania from the Bone Caves of Tennessee. Amer. Nat., July, 1897, pp. 645–650.

humeri shown in Figs. 94, 97 and 100, show very well the greater development of the ulnar crest, as compared with that feature in the humerus of an existing specimen (Fig. 91).

One or two of these *humeri* are very considerably shorter than the one shown in Fig. 91; and, as they are *very dark* or *dull black* and *smooth*, I take it that they belonged to specimens of *Colymbus holbœlli*. Figs. 94, 95 and 96 of Plate XIII are *humeri*, which, had they been perfect, would, beyond any doubt, have been fully the size of the bone shown in Fig. 91; but then their *ulnar crests* would have been different and more prominently produced. What has been stated with respect to the *humerus* will also apply to the other long bones of the pectoral limb.

Many of the avian *ulnæ* in the collection are broken, while many others are very perfect. For a grebe's *ulna*, I selected the one shown in Fig. 116 of Plate XIV, and compared it with one of *Æ. occidentalis*, as set forth in the Explanation of Plates beyond.

Both the *ulna* and *radius* in *average birds* have many characters in common; and, as they vary considerably for *sex*, *age* and other causes, I have used them with extreme caution in making references on these accounts. However, the *ulna* shown in Fig. 116 is from an adult, and more than likely belonged to a *C. holbœlli*.

Only a few of the two *carpal bones* occur in the collection; I made no attempt to refer them, and for very obvious reasons. This also applies to *phalangeal joints* of manus.

With respect to the *carpo-metacarpus*, we have a very different proposition. This long bone in a grebe is very distinctive, as will be appreciated by a study of those presented in Plate XIV, Figs. 103 to 110 inclusive. These bones are referred to quite fully in the Explanation of Plates at the end of this paper. At first glance, the bone shown in Fig. 102, Plate XIV, was thought to be from a grebe; but a more careful study of it revealed the fact that it came from some medium-sized Heron, and it has all the characters — as far as they have been preserved — of an *Ardea*, though possibly it may have belonged to a *Botaurus*. Unfortunately, I have no long bones of the limbs of that genus before me. Figs. 111 to 128 inclusive of Plate XIV give various other bones of the skeletons of grebes for study; and, in the case of the *vertebræ*, it will be noted how perfectly some of them have been preserved. The *superior mandibles*, presented in Figs. 111 and 113, clearly show how these grebes varied in size.

Perhaps no Plate, in the present paper, better explains what I have endeavored to make clear in the last few paragraphs than Plate XV. The twenty figures included upon it are all *femora* of grebes, taken natural size on anterior and posterior views. There is no question in my mind but what

the bones shown in Figs. 129, 130 and 140 on this Plate belonged to specimens of *Æchmophorus occidentalis;* more than likely some of the others did, or *all* the others did, for that matter. The chances are, however, that such femora as are here shown in Figs. 138, 143, 144, 148 and others, belonged to several individuals of *Colymbus holbœlli*. There can really be no certainty — no absolute certainty — on this point, however, as we see from the Plate, that between such a big femur as the one shown in Fig. 140, and the small one in Fig. 144, there is a complete gradation of others, each varying by only a millimeter or more. Therefore, in so far as the femur is concerned — judging from the material at hand — it would appear to be impossible to say, in such a series, exactly where one species began and the other left off. This matter will be touched upon again further on in this paper.

Coming to the *tibio-tarsus* of these grebes, we are met by the same problem that confronted us in the other bones of the skeleton. This I have endeavored to demonstrate by the Figures presented on Plates XVI and XVII. If we allow that the *tibio-tarsus* shown in Fig. 152 be that of a subadult *Æ. occidentalis,*— and I believe it to have belonged to an individual of that species,— then all the bones on Plate XVI were of this Western Grebe. With the exception of the one shown in Fig. 155, they are all fossil.

The several ways in which the *tibio-tarsus* varies — or did vary in the case of *Æ. occidentalis,* during Pleistocene time in Oregon, indeed wherever the species occurred during that epoch — are well shown in Figs. 156–176 of Plate XVII. This is a valuable character display, and worthy of thought and close study.

There are upwards of sixty *tarso-metatarsi* of the larger species of grebes in this collection, and some three or four in the lot belonging to the U. S. National Museum. All these I have studied and compared with especial care; for not only are they very instructive, but they shed considerable light on the variations to be found in these bones of the species to which they belonged. Moreover, Mr. L. H. Miller has likewise written on this subject, and described a fossil extinct grebe from Fossil Lake, Oregon, which he has named *Æchmophorus lucasi.*[1] When Mr. Miller described this extinct grebe, the material at hand for the purpose consisted of six femora and four *tarso-metatarsi* ("tarsi"), and he arrived at his conclusions by the very uncertain test of averages (p. 86) — *i. e.*, the averages based on the lengths of the long bones employed in making the species.

I have shown above, that in the case of any of these long bones (either fossil or recent species) of grebes, they vary in their *lengths* with respect to

[1] Miller, Loye Holmes. Additions to the Avifauna of the Pleistocene Deposits at Fossil Lake, Oregon. Bull. Dept. Geol. Univer. Cal. Pub. Vol. 6. No. 4, pp. 79–87. (Issued Feb. 4, 1911).

sex, age, species, etc. For example, we might have fifty femora or tarso-metatarsi to examine,— all of the larger species of grebes (fossil) from Fossil Lake. In lengths, they may run all the way from 70 to 80 millimeters; were they all confined to *one* species — and when that species became *adult* its tarso-metatarsus always measured 80 mm. — then the taking of averages would be of distinct value in determining *new* species. But this is not the case; for we have at least *two* species of big fossil grebes from the locality in question, and we may have, for example, a *tarso-metatarsus* of an adult *Æchmophorus occidentalis* measure 80 mm.; or every five or six of them out of the fifty, including a few females of the same species, measure 77.5 mm.; a few of *Colymbus holbœlli* adult males also measure 77.5 mm.; and a lot of subadults of *both* species ranging in length between 70 and 75 mm. In other words, we have gradation in lengths in a long bone of *two* species to take the average of the same, with the view of establishing a third species. Such data, based on such material — everything else being equal — is useless, and for this reason I did not take averages of the lengths, in the case of the long series of these bones I have at hand at this writing.

Mr. Miller gives the length of the *femur* of *Æchmophorus occidentalis* — the existing species — as 43.8 mm. I take the femur here shown in Fig. 130 of Plate XV to be a fossil femur of this species, and it has an extreme length of 50 mm.! while the one shown in Fig. 138 of the same Plate has a length of but 42 mm. There are various measurements with respect to the lengths of these bones between these extremes, as they are shown on Plate VII. The gradations are very perfect and gradual. Twenty years ago, when I first examined these fossil bones, I took all the *smaller* ones to belong to *Colymbus holbœlli,* and all the *longest* ones to *Æ. occidentalis.* In other words, *femora,* exactly like the ones figured by Mr. Miller as belonging to his *Æ. lucasi,* I described as belonging to *Æ. occidentalis.* Were that bone *perfect,* it is precisely such a femur as the ones I exhibit in Figs. 131, 132, 133 and others of Plate XV of the present paper, and they are femora of *Æchmophorus occidentalis.*

Still more deceptive, unreliable and unfortunate are the data obtained through the application of length-averages when we employ the *tarso-metatarsus* for this, and expect to establish new *extinct* species thereby. This is well shown in Plate XVIII of the present paper. On it, I have reproduced Mr. Miller's figure of the *tarso-metatarsus* of his *Æchmophorus lucasi,* exactly the same length (74.6 mm.), Fig. 183. Next to it, I present the photograph (Fig. 182) of a fossil *tarso-metatarsus* of a grebe from Fossil Lake, which is precisely like the one Mr. Miller figures (Fig. 183),— even to the imperfection present at the distal end. It measures in length, from

the "intercotylar tuberosity to external trochlea," 74.6 mm., and is considered by me to be the *tarso-metatarsus* of either a female *Æ. occidentalis* or a male *C. holbœlli* (adults),— most probably the latter. Figure 181 in this Plate X is from a recent specimen of *Æ. occidentalis*, and has a length of 79 mm.; Mr. Miller states that the *tarso-metatarsus* in recent specimens of *Æ. occidentalis* has an average length of only 70 mm.

The *tarso-metatarsi* of Plate XVIII, seen in Figs. 185–190 inclusive, appear to have all belonged to specimens of *Æ. occidentalis*, although the shafts are thicker, from side to side, in some than they are in others. (Compare 186 and 188 in this matter.) All this being true, it would be interesting to know to what species of grebes the fossil tarso-metatarsi belonged, shown in Figs. 178, 179 and 184 of my Plate XVIII of the present paper. The bone shown in Fig. 178 has a length of only 69 mm.; while in the one shown in Fig. 184, it equals 86.5 mm.,— a difference of 17.5 mm. The bone shown in Fig. 177, is an extremely heavy and thick one, as compared with the one shown in Fig. 189.

Among all the *phalanges* of *pes*, shown in Plate XIX, it is not difficult to pick out a number which belonged to different species of grebes,— as, for example, the characteristic joints shown in *e* and *f'* and others.

In my Philadelphia Academy memoir, it was set forth that the fossil remains of *Colymbus auritus* probably occurred in the Oregon Desert Region fauna, during the Pleistocene; and that *Colymbus nigricollis californicus* and *Podilymbus podiceps* certainly did, as fossil bones of these two species were met with in the Cope collection. During the present examination, I have been enabled to examine the skeleton of an adult ♂ *Colymbus auritus* (No. 17273, Coll. U. S. Nat. Mus.); and, in comparing some of its bones with certain fossil ones in the collection now before me, I find that a number of the latter can, with certainty, be referred to this grebe. Among these, there are two *tarso-metatarsi* which certainly belonged to specimens of a species so close to *Colymbus auritus* that there can be no doubt as to their identity. It is very remarkable that such a number of the fossil bones, of so many of the avian species of the Pleistocene period, agree so well — in all particulars — with the corresponding bones in the skeletons of their several representatives of modern time,— that is, in our recent birds.

As previously stated, a number of fossil bones, representing *Colymbus nigricollis californicus* and *Podilymbus podiceps*, are to be found in the collection. (See Figs. 443–447, 450–456, 463, Plate XXXVIII, and Figs. 457–462, Plate XXXVIII); these have all been carefully recompared with the corresponding bones in skeletons of recent birds of the same species.

After setting aside all of the fossil material in this collection, representing *Æ. occidentalis, Colymbus holbœlli, C. auritus, C. n. californicus* and *Podi-*

lymbus podiceps, I still find some fossil bones of grebes that cannot be referred to any of these species, and they therefore represent new species of the North American *Pygopodes*.

Descriptions of New Species of Extinct North American Pygopodes.

Colymbus parvus, n. sp.

(Figs. 474–477, 481–483, Pl. XXXIX.)

This was a true grebe, considerably smaller than either *Æchmophorus occidentalis* or *Colymbus holbœlli*, and notably larger than either *Colymbus nigricollis californicus* or *Colymbus dominicus*. Its remains are represented in this collection by at least nine (9) fossil bones, all of which are sufficiently perfect for the purpose of making a correct reference. Seven of these bones are figured on Plate XXXVIII of this paper, they being two *humeri*, two *tarso-metatarsi*, and three *coracoids*. Beyond their relatively small size, there is nothing peculiar about any of these bones,— all being wholly pygopodine in character. The *tarso-metatarsus* has a length of 56. mm. (approx.) (Fig. 477). The three coracoids shown are much worn, and very pale in color. The characteristic *anterior* sternal facet, in all of these coracoids, is very indistinct, as may be observed from the Figures; and this leads me to believe that these three coracoids may have belonged to some other species of water bird, notwithstanding the fact that all their other characters point to a grebe's coracoid. If, however, the aforesaid facets prove to be not present, I would say that these bones did not belong to a grebe, and should therefore be set aside. In this connection I would say, that in the collection there are two other coracoids, small in size, and typically grebe in character, which I can, without hesitation, say belonged to the present new extinct species. Both of these are black in color, from adult individuals, nearly perfect, and one rather larger than the other. The longer one measures, in extreme height (from highest point on summit to apex of outer, lower angle) 41 mm., and the shorter one, on the same line, 39 mm.

Podilymbus magnus, n. sp.

(Figs. 439, 440, 449, 461, 462. Plate XXXVIII.)

Represented in the collection by two *tarso-metatarsi* and a *coracoid*,— all three bones being more or less perfect.

Either of these *tarso-metatarsi* present identically the same characters as are found in the corresponding bone of a specimen of *Podilymbus podiceps*

(No. 17272, Coll. U. S. Nat. Mus.), with this exception that they are very considerably larger, as well as longer. In *Podilymbus magnus*, the *tarso-metatarsus* measured 44 mm. in length, while in *P. podiceps* it measures but 37 mm. Both of these bones of *P. magnus* (lefts) are given in Plate XXXVIII (Figs. 439, 440) to show their agreement. It is not at all likely that they belonged to the same individual. They are compared with the *tarso-metatarsus* of *C. auritus*, in that they may not be confounded with that species. This is also done in the case of the *coracoids* (Plate XXXVIII, Figs. 448, 449); and it will be observed that the coracoid of *P. magnus* is notably slenderer than the coracoid in *Podilymbus podiceps*. In the latter species (recent), it has an average height of 30.5 mm. (measured from highest point on summit to apex of lower, outer angle); while in *P. magnus*, this same line measures 34. mm. Fossil *coracoids* of *Podilymbus podiceps*, agreeing in all particulars with those bones in recent birds of that species, are shown in Figs. 461, 462 of Plate XXXVIII, and these are there to compare with Fig. 449. The shaft of the coracoid of *P. magnus* is longer and slenderer than the shaft of the coracoid in *P. podiceps*,— actually, as well as relatively.

Plate XXXVIII (Figs. 439–463) presents numerous fossil bones of the smaller American grebes, and these can be duly compared, by any student of the subject, with the corresponding bones as they occur in our smaller pygopodine species of the existing avifauna.

Up to the present writing, there have been no species of Loons (Urinatoridæ) or Auks (Alcidæ) found in the collection; and, as to the Lariformes, they were all treated with sufficient detail in my Philadelphia Academy memoir.

No fossil remains of Albatrosses (Diomedeidæ) have thus far come into the hands of science from that region, and this likewise applies to the Tubinares.

Among the Steganopodes — apart from what little was found of a fossil Pelican — the principal bird noted was *Phalacrocorax macropus*, Cope's Cormorant.

STEGANOPODES.

Phalacrocorax macropus *Cope.*

(Figs. 259–288, Plates XII–XV. Fig. 486, Plate XXXIX.)

In my Philadelphia Academy memoir, I present the place of original description of this large, extinct cormorant,[1] first made known to science

[1] Bull. U. S. Geol. and Geogr. Surv. of the Terr., Vol. IV, No. 2 (1878), pp. 386, 387.

by Cope. I also give the number and names of the bones representing it in the collection, and their condition. There is, too, a Table presented in that contribution, in which is given comparative measurements of certain bones of *P. macropus* and *P. carbo.* Some of these bones I briefly describe and state that "In the main, the characters presented on the part of its skeleton (*P. macropus*) agree with those Cormorants now retained in the subgenus *Phalacrocorax*, rather than with the *Urile* group." (pp. 400, 401.)

The present reëxamination of the material tends to confirm this latter opinion; and, as the fossil bones of *P. macropus* have never been illustrated, I have devoted four Plates and many figures to them in the present paper. (Plates XX–XXIII.)

In comparing some of these with the corresponding ones of a skeleton of *Phalacrocorax auritus*, it was not with the view of giving the impression that the extinct form was most nearly related to that cormorant; but rather that I found the skeleton of *P. auritus* most convenient to use for the purpose. (No. 19262, Coll. U. S. Nat. Mus.)

Upon comparison, I find the osteological characters of *P. macropus* agree better with the corresponding ones in a skeleton of *P. urile* at hand (No. 18982, Coll. U. S. Nat. Mus.) than with any other form.

The *tarso-metatarsus* shown in Plate XIV as Fig. 283, is the same bone as shown in Plate XXIII on side view (Fig. 288), where it is compared with the corresponding bone in the pelvic limb of *P. auritus.* It will be noted, that the morphology of the *hypotarsus* in these two forms is somewhat different, especially in the matter of the delicate, spine-like process extending downward on the thickened posterior margin of it, in the case of *P. auritus*, which feature is lacking in *P. macropus* as well as in *P. urile* and *P. pelagicus.*

LIMICOLÆ.

Beyond what has already been set forth in my Philadelphia Academy memoir, I have nothing to add to the description there given of the smaller species of "Shore-birds." Upon making a final attempt to ascertain to what species the few bones of them in the collection belonged, I found it was almost, or quite impossible, to do so. The recent species are very numerous; and, in a good proportion of them, the long bones of the limbs closely resemble each other,— and it is only the fossil long bones that we have. Such a task would be very much like correctly referring a mixed lot of fossil *ulnæ* of the genus *Dendroica* to the proper species. To start with, we had nothing else to go by, in the way of fossil bones, and did not even know that the ones we had were those of the Warblers of that genus.

FULICARIÆ.

(Fig. 480, Plate XXXIX.)

In my previous publication in the Journal of the Philadelphia Academy, I give quite fully all I had discovered with respect to the genus *Fulica*, and the presence of *F. americana* and the extinct species *F. minor* Shuf. in the avifauna of Oregon during Pleistocene time. There is nothing to add to this account, which will, in any way, render it more useful to the vertebrate palæontologist.

GALLINÆ.

(Figs. 1, 4, 6, 7, 9, 11–13, Plate IX. Figs. 472, 473, Plate XXXIX.)

In my former paper, cited several times above, it was shown that this collection contained fossil bones which belonged to *Tympanuchus pallidicinctus*, *Pediocætes p. columbianus*, and such extinct forms as *P. lucasi* Shuf., *P. nanus* Shuf., and *Palæotetrix gilli* Shuf.; but no mention is made of having found any remains of *Centrocercus urophasianus*. There were, however, a number of bones which evidently belonged to some large, gallinaceous species not then recognized. As fossils, they were different from the others; they appeared as though they had been taken from some volcanic formation, and a matrix had adhered to a number of them. Be this as it may, they were not referred to *Centrocercus*.

When the small lot from the National Museum was submitted to me by Mr. Gilmore, fossil bones were found in it which I at once recognized as belonging to the Sage Cock, without even having those of recent specimens at hand for comparison. Then a small lot of fossil bones from Fossil Lake, Oregon, which had belonged to the Cope collection, but which I had never seen before, was sent me by Dr. Matthew of the American Museum of Natural History. In this lot there were also some bones of *Centrocercus urophasianus*. So that, taken altogether, the number of fossil bones of this species, which I have examined in these several lots, is more than ample to establish the fact that that grouse was an abundant species in the Oregon Desert Region during Pleistocene time, and that in the skeleton at least, they agreed exactly with their descendants of present time. This will be appreciated by examining the numerous figures I present on Plates IX and XLI of the present paper.

ANSERES.

(Numerous Figures and many Plates.)

In my previous papers I have already demonstrated the presence of a large number of anserine fowls during Pleistocene time in the Oregon Desert Region. Their fossil bones were found in abundance at Fossil and Silver Lakes and elsewhere. The Mergansers, Ducks, Geese and Swans were far too numerous to list in this place; but their names appear in the recapitulation at the end of this paper. Besides *Lophodytes cucullatus* — the well-known hooded merganser — there were no fewer than ten species of ducks in that ancient fauna, of which fossil remains were found,— demonstrating in each case that the species still exists in our present-day avifauna.

Owing to the greater variety of bird skeletons in the Collection of U. S. National Museum, I am enabled to considerably augment this assemblage by still other species in the present paper.

In Fig. 403 of Plate XXXII, there is given a right *carpo-metacarpus*, which I have carefully compared with the corresponding bone in the skeletons of *Mergus americanus*. It completely agrees with these in its general characters, and departs from them only in the matter of length, being a trifle shorter. Possibly, and I think very probably, it belonged to a female of this species, as the female *Mergus americanus* is considerably smaller than the male. This *carpo-matacarpus* is very much larger than the corresponding bone in a Canvas-back or a Mallard.

Mergansers of the genus *Mergus* possess a very characteristic *femur*, which, everything else being equal, is invariably shorter and thicker than that bone as we find it among the *Anatinæ*. This is well exemplified in the proximal moiety of the fossil femur of *Mergus serrator* shown in Fig. 364 of Plate XXX. This bone agrees exactly with the corresponding part of a femur of a recent *Mergus serrator*,— a skeleton of which is to be found in the Collections of U. S. National Museum (No. 16626). With this specimen before us, there is no question but what this merganser was to be found — though perhaps not abundantly — in the ancient avifauna of Oregon. Indeed, I am of the opinion that the *Merginæ* were comparatively rare during the Pleistocene time in North America, or else their fossil remains would be more plentiful along with all the other *Anatidæ* found at Fossil and Silver Lakes.

There is another part of a fossil *femur* of a species of *Mergus* seen in Fig. 398 of Plate XXXI; but the imperfections present in it preclude the possibility of making a correct reference for it. Figures of such bones, however,

are here presented, in that we may — in the event of obtaining additional material from these ancient lakes of Oregon — have illustrations before us of what has already been obtained from those localities, and in this way afford assistance in making diagnoses.

Among all the *pedal phalanges* figured on Plate XIX, there are doubtless quite a number which belonged to different species of ducks found at Fossil Lake; and when our museum collections contain specimens of all the skeletons, of both sexes and various ages, of North American Anatidæ, the student will be able to readily identify these fossil toe-joints from the figures shown upon this Plate. At the present time, and in the absence of such material, such a task could give satisfactory results only in a comparatively few instances; and there would always be a doubt attached to even these, due to the fact that our material was not complete.

Ducks of the genus *Marila* were fairly represented in the Pleistocene avifauna under consideration; for example, there is, in this collection, a fossil *coracoid* apparently representing *Marila americana*,— the Redhead. This bone is figured on Plate XXXI, Fig. 384. In several respects, however, it more closely resembles the *coracoid* in a small or medium-sized Branta — as *Branta bernicla glaucogastra* for example — especially in the more tuberous head of the bone, and the wider valley between the summit and scapular process. The facets at the sternal end are somewhat different,— all of which inclines me to believe that, eventually, this bone may be found to have belonged to some of the smaller brants of the genus *Branta*. If this comes about, it still remains for some one to discover fossil bones, at those ancient lakes, representing the Redhead (*M. americana*).

Passing to the Canvas-back (*Marila valisineria*), the fossils at hand, representing that species, leave no doubt whatever as to its presence in the avifauna in the Pleistocene of Oregon. These are thoroughly illustrated by the several figures on Plate XXX. They are there duly compared with the corresponding bones in a skeleton of a recent specimen (No. 16245, Coll. U. S. Nat. Mus.), and in every instance they are completely identical; in other words, there have been no appreciable skeletal changes in the case of *Marila valisineria* since the Pleistocene in North America. The *carpometacarpus*, in both fossil and recent specimens, has a length of 51.5 mm., and the *femur* 49. mm. What there is of the fragment of the *tarso-metatarsus*, shown in Fig. 377, is likewise distinctly *M. valisineria*, and identical with that portion of the bone as seen in Fig. 378 of Plate XXX.

As to *Marila marila* and *M. collaris*, their being represented in the collection by fossil bones, depends entirely upon the fact as to whether the *ulna*, given in Fig. 388, Plate XXXI, belonged to one or the other of those species, and not to *Marila affinis*. With respect to the latter duck, how-

ever, there is not the slightest doubt but what the fossil *coracoid* shown in Fig. 392 of Plate XXXI, belonged to an individual of that species. It agrees in every particular with the corresponding bone in a skeleton of a recent specimen (No. 18605, Coll. U. S. Nat. Mus.). The fossil bone is not quite perfect, being slightly chipped at the outer sternal angle, resulting in the loss there of a small, upturned apophysis, seen in Fig. 393. In each case, the straight line, passing from the highest point on the summit of the bone to the apex of the inner sternal angle below, measures 45.5 mm. So well do these two *coracoids* agree (Fig. 392, 393) that the minute ridges on the posterior sternal moiety, indicating the insertion of the fibres of the *subclavius muscle*, are almost identical in the two bones.[1]

When I first examined the material composing this collection, I had at hand no skeleton of a recent specimen of the Buffle-head duck (*Charitonetta albeola*); but since then, the National Museum has acquired one (No. 16627), and I have it before me at the present writing. Fossil bones, which I formerly suspected as having belonged to this species (Figs. 366–369, Plate XXX), have been compared by me with this skeleton, and I can now announce that the former are of *Charitonetta albeola*, and this species can be added to the long list of *Anatidæ* that flourished on these lakes during the Pleistocene period.

There are four fossil *carpo-metacarpi* of *C. albeola* in the collection, and the perfect ones (2), as well as the one of the existing specimen, have each a length of 33. mm. As in the case of these *carpo-metacarpi*, the proximal end of a *humerus* (fossil) of this duck is, in every way, identical with that part of the bone in recent specimens. (Fig. 366, 367.)

Harlequin ducks (*Histrionicus histrionicus*) I can now state with certainty were to be found in the ancient avifauna of Oregon here being considered. The fossils representing this species, however, are few; but such as they are, they agree exactly with the corresponding bones in the skeletons of adults of this duck now existing.

There is a fossil *coracoid* of a Harlequin duck (*H. histrionicus*) in the Collection of the U. S. National Museum (Plate IX, Fig. 16), and it agrees, character for character, as well as in the matter of size, with the corresponding bone in a skeleton of an existing specimen. (No. 223756, Coll. U. S. Nat. Mus.) The counterpart of this bone is to be found in the present collection (Fig. 360, Plate XXX), and this has also been compared with the bone in a recent skeleton. Any of these *coracoids* — be the specimen a fossil or a recent one — measure in a straight line, from the highest point on the head of the bone to its internal angle below, 39. mm.

[1] Shufeldt, R. W. The Myology of the Raven, p. 31, fig. 8, and p. 94. London, 1890.

Among fossil *coracoids* of birds, the commonest imperfection consists in the breaking off of more or less of the outer sternal angle. This considerably alters the appearance of the bone, but does not destroy its usefulness for the purpose of diagnosis nearly so much as one would suppose.

The head of a fossil *humerus*, which belonged to an *Histrionicus histrionicus* in this collection (Fig. 362), is contrasted with the same part of that bone from a recent individual (Fig. 363); and from this comparison, one may see how much the bones of the long-departed birds of this species of those ancient lakes, agreed with harlequins of the present-day avifauna. Osteologically, there is no difference, however much they may have differed in plumages or in other respects.

My reëxamination of the material in this collection has resulted in still another interesting discovery, and adds still another duck to the list. This is none other than Steller's Eider (*Polysticta stelleri*); and, from the many fossil bones I find of this species in the collection, it must have been very numerous during the Pleistocene in this region. There are no fewer than fourteen (14) fossil *coracoids* of this duck at hand, together with three (3) proximal moieties of *humeri;* an imperfect *carpo-metacarpus* (Fig. 374), and a *femur*, which I am inclined to believe belonged to some other species of duck (Fig. 380). However, several of the coracoids are absolutely perfect, and any one of the fourteen agrees exactly with a coracoid of an adult specimen of this eider of the present time. This likewise applies to the *humerus;* so that, osteologically, *Polysticta stelleri* has undergone no change since the Pleistocene period in North America. (Figs. 370, 371, Plate XXX.)

In commenting upon my Philadelphia Academy memoir, Mr. L. H. Miller, in his above cited paper (p. 86), makes the following statement with respect to the Ruddy Duck (*Erismatura jamaicensis*), to wit: it "seems to have been rare in the Pleistocene fauna of the Fossil Lake region. It is not mentioned in Schuffeldt's [*sic*] report on the extensive collections examined by him."

On page 406 of the "report" he refers to, I say: "*Anas strepera* and *Erismatura rubida* may also have figured in former times along with the other fossil forms we have been examining." It would appear that Mr. Miller found a perfect fossil tarsus of this species.

Quite a number of fossil bones in this collection belonged to skeletons of *Erismatura jamaicensis*, which came from Fossil Lake, Oregon. For example the *humerus* on Plate XLII, Fig. 540, which lacks its head, belonged to a duck of that species, as did possibly also the two *femora* in the same Plate, shown as Figs. 550, 553. Either of the latter is almost perfect, as is another *femur* of this duck, shown in Fig. 397 of Plate XXXI. These

femora, with the exception of the bone shown in Fig. 397, are somewhat slenderer, and with smaller heads than in the femur in the skeleton of a recent specimen (No. 11220, Coll. U. S. Nat. Mus.), while the excepted one agrees with the latter exactly in all particulars, and belonged to a Ruddy Duck.

Although I state, in the Explanation of Plates beyond, that the *coracoid* shown in Fig. 390 of Plate XXXI (fossil) belonged to this species, I entertain some doubt on that point; for, while it comes very close to that of the recent specimen (Fig. 391), there are some differences, as for example, the greater width of the valley between the head of the bone (in the fossil one) and the scapular process below it (præcoracoid process of Gadow). This is a radical difference; and if the coracoid in Fig. 390 belonged to a Ruddy duck, the bird has changed considerably, osteologically, since the Pleistocene period. I am more inclined to believe that the coracoid shown in Fig. 390 belonged to some other species of duck, and this for the reason that the *femora* shown in Figs. 396 and 397 are identically alike.

This brings us to a consideration of the *tarso-metatarsi* figured in Figs. 394 and 395 of Plate XXXI. Figure 395 is from a recent specimen (No. 11220, Coll. U. S. Nat. Mus.), the same which furnished the coracoid (Fig. 391) and the femur (Fig. 396), while Fig. 394 is fossil. These two bones are identical in characters, differing only a trifle in lengths. The fossil one, Fig. 394, has a length of 34.5 mm., and the recent one, Fig. 395, a millimeter more, or 35.5 mm. I am inclined to think that the one shown in Fig. 394 came from a female Ruddy Duck, which will account for its smaller size. There is no question, however, but that it belonged to a specimen of *Erismatura jamaicensis*, and would of itself be sufficient evidence of the presence of that species at Fossil Lake during the Pleistocene period. Indeed, it was upon a "perfect tarsus" that Mr. Miller established this fact. (Geol. Bull. Univ. Cal. Vol. 6. 1911, p. 86.)

ANSERINÆ AND CYGNINÆ.

(Numerous Figures and Plates.)

On Plate XXIV are presented some interesting figures of fossil bones of the Snow Goose (*Chen hyperboreus*), and of the White-fronted Goose (*Anser albifrons gambeli*). These are sufficiently described in my Philadelphia Academy memoir (pp. 408, 409), but are now figured for the first time.

Carpo-metacarpi of several species of existing and extinct geese are also presented on Plate XXV, and these, arrayed as they are, are very valuable for the purposes of comparison. All of these have been more or less fully

described, either by Cope or myself, but never heretofore illustrated as they are in this Plate. In Fig. 305 will be noted a peculiar pathologieal exerescence on the extremity of the pollex metaearpal. This occurs not only in fossil specimens, but is found in the same locality on the *carpo-mataearpi* of existing ones. This applies particularly to Swans and Geese, but it is likewise found in the same place among the larger *Raptores*. Many years ago, I more or less fully described this interesting feature.[1] It is shown to some extent on the bone given in Fig. 304; and, in the ease of an existing eagle at hand, this enlargement is of very considerable size (*Haliæetus leucocephalus*, No. 19384, Coll. U. S. Nat. Mus.).

In that we may compare the fossil and recent *scapulæ* of these Snow and Blue Geese, I have presented, on Plate XXVI, several figures to that end. In Figs. 306 and 307, for example, we find the anterior portions of the *scapulæ* (fossil) of *Chen cærulescens;* and in Fig. 312, on the same Plate, a *scapula* of an existing specimen of this Blue Goose. It will be observed that they are identieal in all particulars. The *pneumatic foramen*, on the dorsal side of the extreme anterior end, is characteristic of the scapulæ in Geese, but is absent in Swans, both recent and extinct. (See Figs. 309, 310.)

As we would expect, the *scapula* of *Chen h. nivalis* is larger than in *C. cærulescens*, as the bird itself is larger, and this is well seen in Fig. 308, which is a part of a fossil scapula of a Greater Snow Goose. Still another fossil one of this species is given in Fig. 314. Curiously enough, most of the larger scapulæ in this colleetion (fossils) have been broken in two,— the hinder portion seemingly having been lost in every instance.

On Plate XXXIV (Figs. 416, 417), a comparison is made, along with other anserine fowls, of the *coracoids* of *Chen cærulescens* and *Chen h. nivalis;* and again on Plate XXXVI (Figs. 426, 427), the same is done with respect to the *femora* of the birds. Such comparisons show very well that, although in these series of bones great difference in size is exhibited, the corresponding eharacters in all are essentially the same. And, when we come to consider for a moment the differences in such bones, due to individual variation, sex, age, and time,— what an easy matter it is, in the case of large collections like the present one, to find material upon which to base new and extinct speeies.

Anser condoni, and the fossil material representing it, has been so fully described and illustrated in my Academy memoir that it would be quite superfluous to add anything in regard to it here. (See Plate IX, Fig. 3.) As

[1] Shufeldt, R. W. Notes on Palæopathology. Pop. Sci. Monthly, Vol. XLII, No. 5, New York, Mar., 1893, pp. 679–684. Attention is invited to Fig. 2. of that contribution. (Compare with Fig. 422, Pl. XXVII of the present paper; it is the same bone. Fig. 2, however, in the 'Popular Science Monthly' article should be corrected so as to read *anconal* for "outer aspect," and *Olor matthewi* for *Olor paloregonus*.)

to *Anser albifrons gambeli*, Cope has long ago established its presence in the avifauna of the Pleistocene of Oregon, and all that is required with respect to this goose here, is to illustrate the fossil bones from which he made his references.[1] This I have accomplished through numerous figures on the Plates; for example, in Plate XXIV, fossil bones of this, the White-fronted Goose, are compared with the corresponding ones of *Chen hyperboreus;* and with respect to *Anser a. gambeli*, the bones here used were Cope's types.

Again, in Plate XXXII (Figs. 408–411), we have a *femur*, two *coracoids*, and a part of a *carpo-metacarpus* of this goose shown,— all natural size, and agreeing in all respects with the corresponding bones in the skeletons of recent examples, with which I have compared them.

Already it has been pointed out, in my previous writings, that the Canada Goose (*Branta canadensis*) was an abundant species on the waters of the lakes of central Oregon during the Pleistocene period. Numbers of its fossil bones, from both adult and subadult individuals of both sexes, form a part of the collection here being considered. Being above medium size, they are, almost without exception, in a fragmentary condition; for, with fossils like these, of the birds from Fossil Lake, it is the big bones which get broken up, and not those of the smaller species. For example, the long bones of an adult Green-winged Teal (*Nettion carolinense*) are the ones we find unbroken, as compared with those of the Swans, larger Brant geese, etc. This seems to hold particularly true of the humerus.

Fossil bones, fragmentary and otherwise, of the Canada Goose (*B. canadensis*) are grouped on Plate XXVIII of this paper, and they give an excellent idea as to how we find them at Fossil Lake.

Fig. 334 exhibits very well the coössified excrescence on the pollex metacarpal described in a previous paragraph. There might have been some little doubt attached to the proximal part of the *tarso-metatarsus* shown in Fig. 343; but this doubt was dispelled in a way that sometimes — though very rarely — happens. At first I was inclined to believe that it belonged to a *Branta hypsibata* Cope, and it was not until the Plate was entirely finished that I discovered that this piece belonged with the part shown in Fig. 340,— not the least particle having been lost; the two parts were mixed up with all the rest of the collection. By the merest chance, I found they fitted together, and when so fitted, the line of fracture cannot be discerned, while it was at once evident that the bone belonged to a *Branta canadensis*.

As to the toe-joint in Fig. 342, I may say that it agrees exactly with the

[1] Cope, E. D. Bull. U. S. Geol. and Geogr. Surv. Terrs., 1878, IV, p. 389.

basal phalanx of the mid-anterior toe of the left foot of a speeimen of the existing *Branta canadensis*. It is viewed upon dorsal aspeet; and, in order to aseertain to which foot this joint belongs, one should hold the bone with the dorsal surface toward one. When in this position, the apophysis for ligamentary attachment is on the *outer* side of the bone; so that if it is on the left outer side, it belongs to the left foot, and *vice versa* for the right. Other figures for *Branta canadensis* oecur on Plate XXXIII, Fig. 415; Plate XXXIV, Fig. 418, and Plate XXXVI, Fig. 428.

There are several bones, or fragments of bones, in this eolleetion, whieh belonged to representatives of the genus *Branta*, that are not only from fully adult individuals, but from Geese smaller than the Canada Goose. Among these, I do not reckon either *B. hypsibata* or *B. propinqua*. Some of these may have belonged to *Branta c. hutchinsi* and others to *B. c. minima;* but, unfortunately, no skeletons of reeent speeimens of these two species are at hand; so this matter must remain in doubt until the aforesaid material for eomparison is available.

The distal moiety of the *humerus* shown in Fig. 414, Plate XXXIII, I am quite confident must have belonged to an individual of the goose we now designate as *B. c. hutchinsi;* while the *tibio-tarsus* on the same Plate shown in Fig. 412 — although smaller than the one from a reeent speeimen (Fig. 413) — I believe to have belonged to a Canada Goose (*B. canadensis*).

There is good ground for believing that the little Caekling Goose (*Branta minima*) was also represented in this ancient avifauna of the Oregon Desert Region, and in support of this we find a few Brant's fossil bones in the colleetion like the *femur* and *humerus* figured on Plate XXXVIII (Figs. 464 and 465), both of which belonged to a true Brant, and one eonsiderably smaller than *Branta propinqua* Shuf.

Other fossil Brant bones I refer to *Branta bernicla* — or more properly, perhaps, to the goose we now designate as *B. b. glaucogastra* — and the eolleetion eontains *coracoids* of sueh a species (Plate XXXII, Figs. 400–402, 404). These I have eompared with eoracoids belonging to skeletons of Brant in the Colleetions of the U. S. National Museum, and these examinations have eonvineed me of the correetness of these references. They are slightly shorter and otherwise smaller than the eorresponding coraeoids of Nos. 17613 and 17616 (Coll. U. S. Nat. Mus.), but agree exaetly with them in charaeters. It is well known that they vary in the matter of size, both for age and somewhat for sex, and we must make due allowanee for this.

Nearly thirty-five years ago, Cope deseribed the extinet goose, *Branta hypsibata*,[1] written by him *Branta hypsibatus*. The referenee was made

[1] Cope, E. D. Bull. U. S. Geol. and Geogr. Surv. Terr., VI, No. 2, 1878, p. 387.

upon a single bone, a right *tarso-metatarsus*, and this bone is shown in Fig. 320 of Plate XXVII of the present paper. It is imperfect, to the extent of having the hypotarsus almost entirely broken off, as well as the posterior parts of the distal trochlæ. This now long-extinct species was apparently about the size of *Branta canadensis;* but the bones of the skeleton were stouter and of different proportions. The extreme length of this bone is 90 mm. The length of the *tarso-metatarsus* shown in Fig. 319 equals 88 mm.; and I am very much inclined to believe it belonged to a subadult individual of *Branta canadensis*. As will be noted, it is a much slenderer bone than the one shown in Fig. 320. In the recent Canada goose (*B. canadensis*, adult, No. 17980, Coll. U. S. Nat. Mus.), this bone has an extreme length of 93.5 mm., and a transverse width, at the middle of its shaft, of 8 mm.— this being only 6 mm. in the bone shown in Fig. 319. With these proportions as a guide, I have selected fossil bones of geese (*Branta*) out of this collection which, apparently, did not belong to *Branta canadensis*, and referred all such to *Branta hypsibata* of Cope. Examples of these bones are well shown in Plate XXVII of this paper.[1]

Some interesting fragments of bones are to be seen in Figs. 324, 326 and 327 of Plate XXVII. They are parts of lower mandibles of some large anserine bird, and of a species that is now extinct. These pieces are all from the same species; all from adult individuals, and taken upon their outer aspects. They represent similar pieces in the collection, but the three here shown are typical. Each piece extends from just anterior to the splenial vacuity to the symphysis — or rather the symphysial portion of the dentary — all having been broken in a similar manner. These mandibles are altogether too large for the biggest of Canada Geese (*B. canadensis*), or, indeed, for any of our existing Swans (Olor), with examples of all of which I have compared them. However, they are distinctly *goose* (Anser) and not *swan* (Olor). In my opinion, they each and all belonged to different adult individuals of *Anser condoni*, and to that extinct anserine I here refer them.

Branta propinqua Shuf. was fully dwelt upon in my Philadelphia Academy memoir on pages 407 and 408, and a drawing of the type *humerus* of this now extinct Brant was given on Pl. XV (Fig. 17) of that contribution. I have nothing to add to that account here, and I will complete my history of that species with a number of illustrations of the fossil bones representing it. Plate XXIX of this paper is devoted to the purpose, and the *humerus* there shown in Fig. 350, is the same bone as cited above, while all the others appear for the first time. Their characters and measurements are recorded in the Academy memoir.

[1] Compare Figs. 319, 320, Plate XXVII with Fig. 340, Plate XXVIII. Fig. 341, Plate XXVIII with Fig. 330, Plate XXVII, and other similar comparisons of the corresponding bones.

Cygninæ.

No part of the material in this collection of fossil birds requires more careful revision than that which represents the Swans. This it will fully receive in the present paper; and fortunate it is, that what I have here to announce will in no way disturb the status of either extinct or existing species, as they have for a long time been recognized.

Many years ago, when Professor Cope placed this collection in my hands for description and publication, he had already referred the fossil bones of a large Swan in it to an extinct species, *Olor paloregonus*, which he had published in his paper on the subject.[1] He based this new species on the discovery of "four tarso-metatarsi, two of which are nearly perfect," of which he gave full measurements in his above cited account. He claimed that *Olor paloregonus* was a species rather larger than our existing *Olor buccinator*, but somewhat smaller than *Olor americanus*. These "four tarso-metatarsi" were sent to me along with the other material, and I was told that numerous other fossil bones represented *Olor paloregonus* in the collection, including what was subsequently submitted to me as belonging to Professor Thomas Condon, which consisted of an "imperfect *humerus*" and other bones. All of this material is now before me for revision, including a more extensive collection of skeletons of existing species of *Cygninæ*.

Professor Cope did not recognize the presence of any of our recent species of Swans in the Pleistocene fossils, nor any other species of existing Swans beyond his *Olor paloregonus*, and this opinion I have never for an instant questioned. Indeed, I went still further; for I carefully measured all the other fossil swan bones, which had been placed in my hands as belonging to *Olor paloregonus*, and published those measurements in my Philadelphia Academy memoir (p. 409). These measurements are as follows:

Length of humerus (restoration from two individuals)	290 mm.
Length of ulna	255 "
Length of carpo-metacarpus	141 "
Length of proximal phalanx of index digit	59 "
Length of femur	110 "
Length of coracoid (long axis)	97 "
Length of basal phalanx, mid-anterior toe	67 "

Now this material, taken collectively, not only contains the fossil remains of *Olor paloregonus* of Cope,— a perfectly good extinct species which will stand,— but also the fossil bones of another large extinct Swan,

[1] *Ibidem*, pp. 388, 389. (*Cygnus paloregonus.*)

which will be referred to below; and, finally, fossil bones representing both of our existing North American species of the *Cygninæ*,— that is, *Olor americanus* and *Olor buccinator*. All of this will at once be recognized through the aid of the Plates, Figures and other data, which I shall now proceed to present.

First, as to the material representing *Olor paloregonus* Cope; it consists of the following fossil bones:

Nineteen *vertebræ* (all to a few being cervicals); and, as an example of them, the nineteenth *cervical vertebra* is here figured (Plate XXXV, Fig. 425).

Parts of the *shoulder girdle* (*os furcula*); these are correctly described and figured in my above cited paper, published by the Philadelphia Academy, on Plate XVI (Figs. 18, 21 and 25).

Anterior portions of two *scapulæ*, the more perfect one being given in Plate XXVI, Fig. 310 of the present paper.

One *coracoid*, nearly perfect (Plate XXXIV, Fig. 420), and three other coracoids. Length 97 mm. The same bone as given in list.

Four fragments representing the *sternum*.

The *humerus* (Condon collection), listed above as measuring 290 mm., and referred to in my former paper. Five fragments of five other *humeri*.

Three fragments of *radii* (one proximal end, and two distal extremities). (The *ulna* listed above as measuring 255 mm. is an *ulna* of *Olor buccinator*. See Plate XXVI, Fig. 317, as compared with Fig. 318).

One almost perfect *carpo-metacarpus* (here shown in Fig. 421 of Plate XXXV), and fragments of *four* other *carpo-metacarpi*. Length 157 mm. The one in the above list belongs to another species of Swan.

Proximal phalanx of the index digit of the right pectoral limb. (Plate XXVI, Fig. 316.) Length 56 mm. (not 59 as in above list).

A nearly perfect *femur* (Plate XXXVI, Fig. 431), and a fragment of another. Length 110 mm.

Fragments of three *tibio-tarsi* and the proximal end of a *fibula*.

Of the *tibio-tarsi*, one very imperfect anterior part, and nearly perfect examples of anterior and posterior extremities.

The collection contains *five* (instead of *four*) *tarso-metatarsi* of Swans; and the *four* described by Cope as belonging to *Olor paloregonus*, do not belong to that extinct swan, but are fossil *tarso-metatarsi* representing two recent forms, namely: *Olor americanus* and *Olor buccinator*, as will be appreciated by a study of the Figures (433–438) of Plate XXXVII given beyond. Three of the four *tarso-metatarsi* mentioned by Cope, are given in that Plate (Figs. 435, 436 and 438); while another (with imperfect extremities) is not given. This (the *fourth one*) evidently belonged to an

Olor paloregonus. The *fifth* — (not figured), is another important one; for, beyond all doubt, it represents a *tarso-metatarsus* of *Olor paloregonus.*[1]

Seven *phalanges* of *pes* in the collection are hereby referred to *Olor paloregonus.* They are more or less perfect, and their great size may be appreciated by referring to Fig. 257 of Plate XIX of this paper. It is the joint listed above, and measures — as there correctly stated — 67 mm.

In addition to five *vertebræ* (three cervicals and two dorsals), an imperfect upper portion of a *tarso-matatarsus,* and the upper and lower extremities of two *femora, Olor buccinator* is represented in the collection by the fossil bones seen in the Plates and Figures of this paper. (Plate XVIII, Fig. 317; Plate XXXVII, Figs. 433, 435, 436.) These several bones agree with the corresponding ones of recent specimens of this Swan, with which I have compared them.

Olor americanus is represented by a single *tarso-metatarsus,* here shown in Fig. 438 of Plate XXXVII. It presents all the characters in agreement with that bone in a recent specimen (No. 18571, Coll. U. S. Nat. Mus.). It is very considerably smaller than the *tarso-metatarsus* in *O. buccinator.*

After setting aside all of the fossil bones in this collection, belonging to the *Cygninæ,* of the Oregon Desert Region, I find still left a number of fossil bones belonging to another extinct Swan, which was considerably smaller than *Olor paloregonus* of Cope, and larger, by far, than *Olor buccinator.* This Swan has heretofore not been described, and I propose that it be known as *Olor matthewi,* naming it for Doctor William Diller Matthew of the American Museum of Natural History.

Olor matthewi n. sp.

Fossil bones, representing this extinct Swan of the Pleistocene of Oregon, are in the Collections of the American Museum of Natural History of New York City.

These bones consist of *two carpo-matacarpi,* for adult individuals and each nearly perfect, and of two *scapulæ,* the anterior portion only of each.

A *carpo-metacarpus* of *O. matthewi* is here shown in Plate XXXV,

[1] It is imperfect, being only the anterior portion of the proximal two-thirds of the bone; but it is ample to show that it belonged to a Swan much larger than any of the existing species. The transverse diameter of the summit of this *tarso-metatarsus* of *O. paloregonus* measures 28 mm.,—a measurement that never exceeds 26 mm. in *O. buccinator,* whether fossil or recent. In the *tarso-metatarsus* shown in Fig. 432 (Plate XXXVII), the same diameter measures only 26 mm. Where Professor Cope got that specimen, I am not informed; nor can I say, at this writing, to what species of recent Swan it belongs. It is numbered on the shaft 8033, so it is evidently a borrowed specimen. The osteological catalogue (Birds) of the U. S. National Museum gives no definite information on the subject. Possibly it may be the *tarso-metatarsus* of some large foreign Swan; in any event, it is smaller than the *tarso-metatarsus* of *Olor paloregonus.*

Fig. 422, where it is compared with the corresponding bone in *Olor paloregonus* and *Olor buccinator.* It will be observed that it is intermediate in size between these two species; while, at the same time, it exhibits all the characters of a cygnine carpo-metacarpus. Attention is invited to the form and size of the projection at the head of the bone, formed by the pollex metacarpal. It projects further from the bone than does the same part in *Olor paloregonus,*— relatively, as well as actually. In fact, its transverse diameter in *O. matthewi* equals 18 mm.; while in *Olor paloregonus* it is but 15 mm. Judging from this and other characters, I should say that the *carpo-metacarpus* of *Olor matthewi* was more like that bone in *O. buccinator,* than it is like the *carpo-metacarpus* of *Olor paloregonus.*

This resemblance also applies to the scapula (Plate XVIII, Figs. 309, 310), where the marked deflection outwards of the blade of the bone, a short distance from the head, as seen in *Olor paloregonus,* is entirely absent in *Olor matthewi* and *Olor buccinator,* and such departures may hold true with respect to other bones of the skeletons.

When adult, *Olor matthewi* was a swan one-third larger than *Olor buccinator,* and one-third smaller than *Olor paloregonus,*— all these forms probably presenting very marked specific differences.

PHŒNICOPTERI.

Cope's Flamingo (*Phœnicopterus copei,* Shuf.). There is nothing to be added to the account I have given of this extinct species in my Philadelphia Academy memoir on pages 410 and 411. So far as I am aware, there has been no additional material, representing this species, collected at the Fossil Lakes of Oregon.

HERODIONES.

Botaurus lentiginosus: Owing to the fact that there was no skeleton at hand of the Bittern, when I first examined this collection, its fossil bones were not recognized with sufficient certainty to pronounce upon them. Recently, however, I have had access to a number of skeletons of *Botaurus,* and I can now announce positively that it formed a part of the avifauna of the Pleistocene of Oregon. In Fig. 102 of Plate XIV of this paper is shown the right *carpo-metacarpus* of an adult *Botaurus lentiginosus,* where it is compared with a series of that bone belonging to various species of Grebes. At first, I was under the impression that this *carpo-metacarpus* belonged to a medium-sized Heron of some kind, as all of our smaller herons average about the same size (length 23.5 to 24.5 inches), and I so announced it. But

upon critically comparing it with the right *carpo-metacarpus* of an adult *B. lentiginosus* (No. 19255, Coll. U. S. Nat. Mus.), I find the two bones to agree exactly in all particulars. It is a well-known fact, that of all the Herodiones in this country, no species exhibits so marked differences in the matter of size, for sex and age, as does this Bittern.

In this collection, too, there are two *coracoids* of *Botaurus lentiginosus*, and these I have figured on Plate XXXIX (Figs. 468, 470). It will be observed that they depart in no particular from that bone as we find it in the skeleton of the adult bittern of the species, now existing in our United States avifauna.

Ardea herodias: It is somewhat remarkable that there were not more fossil bones of Herons and their near congeners found at Fossil Lake,— especially as they were inhabitants of its shores; while eagles, grouse, and other forms were not especially so,— not any more, perhaps, than the latter are at the present time. Yet we find there just as many fossils of such birds — or indeed more — than we find of the aforesaid waders. This is a little strange; for the scapula of *Ardea herodias*, here shown on Plate XXXIX (Fig. 466), is, in every detail, like that part of the bone as it occurred in a recent individual (Fig. 467). Possibly, herons were by no means abundant at those ancient lakes, or perhaps they may have resorted to heronries at some distance from them; and when they died, they died at those heronries, and not on the shores or in the waters of the lakes in question. However this may be, the Great Blue Heron, the Bittern, and *Ardea paloccidentalis* Shuf. all were members of the northwestern part of this country during the Pleistocene period, and, osteologically, they agreed with their descendants of modern times.

ACCIPITRES.

Aquila chrysaëtos: There were two extinct eagles of the genus *Aquila* described by me, when I first examined this collection, namely: *A. pliogryps* and *A. sodalis*, and I suspected that others of the group would be met with. In this we are not disappointed, for the Golden Eagle was likewise a visitant to the shores of those ancient Oregonian lakes, as one will appreciate by examining the fossil bones we have at hand of that species. They agree with the corresponding parts of the skeleton in the recent form, and are well shown, in a comparative way, on Plate XL of the present paper in Figs. 490, 492, and 495.

Aquila haliæetus: Of this species of eagle I find only one fossil bone, but there is not the slightest doubt of its identity; and, although a little imperfect, it belonged to a White-headed Eagle that existed during the

Pleistocene in Oregon. It is shown in Fig. 496 of Plate XL, where it is compared with the corresponding phalanx of manus from a recent individual, also with the corresponding joint in a Golden Eagle (Fig. 493), in which latter species the form of that phalanx is very different, being much shorter and broader.

Such Striges and Passeriformes as occur in this collection have already been pointed out by me in my Philadelphia Academy paper, and they are enumerated in the recapitulation of species given below.

MAMMALIA.

Such fossil mammal bones as are found in this collection, occur there only through accident, as it was supposed that Professor Cope removed all of that Class for his own descriptions. However, a few remained; and a still smaller number occurred in the lot of fossils submitted me by Mr. Gilmore for description. The latter are all figured on Plate X of the present paper, and all those forming a part of the American Museum of Natural History Collection are shown on Plate XI (Figs. 61–67) and on Plate XLIII. They are principally of Leporidæ and Canidæ, with a part of a tooth of a camel (Camelops). As they are all of forms described and published long ago, they stand in no need of description in this paper. Figures of them, however, will be found to be useful to the palæontologist, and for this reason I have devoted rather more than a Plate to them, while the animals they represent are sufficiently set forth in the Explanation of Plates given beyond.

Notwithstanding the fact, that some twenty-five more species of birds are here added to the Pleistocene avifauna of the Oregon Desert Region, they are all simply forms which either occur in that same section of the country now, or, if not extinct, but still occurred there, they would not have caused us any surprise; and the only remarkable ones that lived upon the shores of those vast lakes, which, during the interval of many thousands of years, have almost dried up, are Cope's Flamingo and a giant representative each for the two families of the Swans and the Geese.

Recapitulation of the extinct species of Birds found in this Collection, as well as those species of the existing American Avifauna which are likewise represented by fossil material.

On the one hand, this list sets forth all the species described by me in the Journal of the Academy of Natural Sciences of Philadelphia or elsewhere (Vol. IX, Pls. XV–XVII, Phila. Oct. 1892, pp. 389–425), and upon the other, all the new extinct forms and the references to existing species

recorded in the present contribution. The tabulation adopted explains itself; while the classification employed is my own, as previously published. (The Amer. Nat., Vol. XXXVIII, Bost. 1904, pp. 833–857.)

All the extinct species described, or existing ones referred to prior to those noticed in the present paper, are arrayed under the year 1892, while the latter fall under the year 1912.

1892.	1912.

PYGOPODES.

1. *Echmophorus occidentalis* (Lawr.).
2. *Echmophorus lucasi?* L. H. Miller.
3. *Colymbus holbœlli* (Reinh.).
4. *Colymbus auritus* Linn.
5. *Colymbus nigricollis californicus* (Herm.).
6. *Podilymbus podiceps* (Linn.).
7. *Colymbus parvus* sp. nov. (extinct).
8. *Podilymbus magnus* sp. nov. (extinct).

1892.	1912.

STEGANOPODES.

9. *Phalacrocorax macropus* Cope (extinct).
10. *Pelecanus erythrochynchus?*

LONGIPENNES.

11. *Larus argentatus* Pontop.
12. *Larus robustus* Shufeldt.
13. *Larus californicus?*
14. *Larus oregonus* Shufeldt.
15. *Larus philadelphia* (Ord).
16. *Xema sabini* (Sabine).
17. *Sterna elegans?* Gambel.
18. *Sterna fosteri?* Nuttall.
19. *Hydrochelidon nigra surinamensis* Gmel.

LIMICOLÆ.

20. *Lobipes lobatus* (Linn.).

FULICARIÆ.

21. *Fulica americana* Gmel.
22. *Fulica minor* Shufeldt.

GALLINÆ.

23. *Tympanuchus pallidicinctus* (Ridgway).
24. *Pediocœtes phasianellus columbianus* (Ord).
25. *Pediocœtes lucasi* Shufeldt.
26. *Pediocœtes nanus* Shufeldt.
27. *Palœotetrix gilli* Shufeldt.
28. *Centrocercus urophsianus* (Bonaparte).

ANSERES.

29. *Mergus americanus ?* Cassin.
30. *Mergus serrator* Linn.
31. *Mergus ?*.
32. *Lophodytes cucullatus* Linn.
33. *Anas platyrhynchos* Linn.
34. *Mareca americana* (Gmel.).
35. *Nettion carolinense* (Gmel.).
36. *Querquedula discors* (Linn.).
37. *Querquedula cyanoptera* ? (Vieillot).
38. *Spatula clypeata* (Linn.).
39. *Dafila acuta* (Linn.).
40. *Aix sponsa* (Linn.).
41. *Marila americana* ? (Eyton).
42. *Marila valisineria* (Wilson).
43. *Marila marila* (Linn.).
44. *Marila affinis* ? (Eyton).
45. *Marila collaris* ? (Donovan).
46. *Clangula islandica* (Gmel.).
47. *Charitonetta albeola* (Linn.).
48. *Harelda hyemalis* (Linn.).
49. *Histrionicus histrionicus* (Linn.).
50. *Polysticta stelleri* (Pallas).
51. *Erismatura jamaicensis* (Gmel.).
52. *Chen. h. hyperboreus* (Pallas).
53. *Anser condoni* Shufeldt.
54. *Anser albifrons gambeli* Hartlaub.
55. *Branta canadensis* (Linn.).
56. *Branta c. hutchinsi* ? (Richardson).
57. *Branta c. minima* ? Ridgway.
58. *Branta bernicla* (Linn.).
59. *Branta hypsibata* (Cope).
60. *Branta propinqua* Shufeldt.
61. *Olor paloregonus* (Cope).
62. *Olor americanus* (Ord).
63. *Olor buccinator* (Richardson).
64. *Olor matthewi* sp. nov.

PHŒNICOPTERI.

65. *Phœnicopterus copei* Shufeldt.

HERODIONES.

66. *Botaurus lentiginosus* (Montagu).
67. *Ardea paloccidentalis* Shufeldt.
68. *Ardea herodias* Linn.

ACCIPITRES.

69. *Aquila pliogryps* Shufeldt.
70. *Aquila sodalis* Shufeldt.
71. *Aquila chrysaëtos* (Linn.).
72. *Haliæetus leucocephalus* (Linn.).

STRIGES.

73. *Bubo virginianus* (Gmel.).

PASSERIFORMES.

74. *Euphagus affinis* (Shufeldt).
75. *Corvus shufeldti* Sharpe.

EXPLANATION OF PLATES.

[The figures in all the Plates are reproductions of photographs made direct from the specimens by the author.]

Plate IX.

[Figures 1 to 35 inclusive on Plates I and II represent material from the Palæontological Collections of the U. S. National Museum.]

Fig. 1. Dorsal aspect of ninth *cervical vertebra*, *Centrocercus urophasianus;* probably ♀. Nat. size.

Fig. 2. Distal extremity of right *humerus* of *Chen hyperborcus*, anconal aspect. Nat. size.

Fig. 3. Dorsal aspect of a *cervical vertebra* of *Anser condoni* Shuf. Nearly complete and natural size. This is the fifth, sixth or seventh of the cervical part of the column.

Fig. 4. Left *carpo-metacarpus* of *Centrocercus urophasianus*, ♀, palmar aspect; nat. size. Probably the bones shown in figures 6, 7, 11, 12 and 13 all belonged to the same individual.

Fig. 5. Anterior aspect of the distal extremity of the right *tarso-metatarsus* of *Branta hypsibata* Cope. Nat. size and perfect as far as it goes.

Fig. 6. Posterior aspect of the right *tarso-metatarsus* of *Centrocercus urophasianus*, ♀. Nat. size and quite perfect. Probably belonged to the same skeleton with Figs. 4, 7, 11, 12 and 13.

Fig. 7. Anterior aspect of the left *tarso-metatarsus* of *Centrocercus urophasianus*, ♀. Nat. size and almost perfect. Probably belonged to the same skeleton as bones shown in Figs. 4, 6, 11, 12 and 13.

Fig. 8. Anterior aspect of the proximal two-thirds of the left *tarso-metatarsus* of *Colymbus holbœlli*. Hypotarsus imperfect. See Fig. 34, Plate X. Nat. size.

Fig. 9. Proximal extremity of right *carpo-metacarpus*, palmar aspect, of *Centrocercus urophasianus*, ♂. Nearly perfect as far as it goes.

Fig. 10. Anterior aspect of left *tarso-metatarsus* of *Æchmophorus lucasi ?* Miller. Nat. size and quite perfect. See Fig. 33, Plate X.

Fig. 11. Anterior aspect of the sternal extremity of the right *coracoid* of *Centrocercus urophasianus*, ♀. Nat. size and perfect as far as it goes. Probably belonged to the same skeleton as the bones shown in Figures 4, 6, 7, 12 and 13.

Fig. 12. Anterior view of the proximal end of the right *tibio-tarsus* of *Centrocercus urophasianus*, ♀. Nat. size and imperfect.

Fig. 13. Anterior aspect of the left *tibio-tarsus* of *Centrocercus urophasianus*, ♀. Nat. size and imperfect. Bones shown in Figs. 4, 6, 7, 11 and 12 and this one, all probably belonged to the same individual.

Fig. 14. Anterior aspect of the distal moiety of the left *tarso-metatarsus* of *Æchmophorus occidentalis*. Nat. size and slightly imperfect.

Fig. 15. Posterior aspect of right *femur* of *Æchmophorus lucasi ?* adult. Nat. size. Imperfect. Found with the *tarso-metatarsus* shown in Fig. 10 and Fig. 33. See also Fig. 32, Plate X, which is another view of this femur.

Fig. 16. Anterior aspect of left *coracoid* of *Histrionicus histrionicus*, adult. Nat. size.

Plate X.

Figs. 17–21. Five *vertebræ* of a teleosteon fish, giving various views. Species not ascertained. Nat. size.

Fig. 22. Right upper free extremity of the *furculum* of a medium-sized anserine bird the size of a mallard. Nat. size, outer aspect; adult. Species not determined.

Fig. 23. Right *palatine* of a teleosteon fish, outer aspect, natural size. Belonged to an individual fully 15 inches in length. Species not determined.

Fig. 24. Distal extremity of a *metatarsal* of a canid (*Vulpes ?*) Palmar aspect, nat. size.

Fig. 25. Distal extremity of the third or fourth *metacarpal* of *Canis lupus* (*occidentalis ?*). Nat. size, palmar aspect.

Fig. 26. First *rib* of left side of a specimen of *Canis lupus* (*occidentalis ?*). Nat. size; posterior surface.

Figs. 27–30. Long bones of the feet of a *Lepus* (sp.?). Nat. size.

Fig. 31. *Calcaneum* of a species of *Lepus*, left foot, dorsal aspect; nat. size.

Fig. 32. Inner aspect of the right *femur* of *Æchmophorus lucasi*. Same bone as shown in Fig. 15, Plate IX. Nat. size. Found with the metatarsus found in Fig. 33. Imperfect.

Fig. 33. Outer aspect of the left *tarso-metatarsus* of *Æchmophorus lucasi* Miller. Nat. size. Same bone as shown in Figure 10, Plate IX.

Fig. 34. Inner aspect of the proximal two-thirds of the left *tarso-metatarsus* of *Colymbus holbœlli*. Same fragment as shown in Fig. 8, Plate IX. Nat. size.

Fig. 35. Inner aspect of the distal moiety of the left *tarso-metatarsus* of *Æchmophorus occidentalis*. Same bone as shown in Fig. 14, Plate IX. Nat. size.

Plate XI.

[All the material on this Plate, as well as on the remaining Plates of the present article, illustrate the fossils in the Cope and Condon collections of the American Museum of Natural History, New York City, and are reproductions of photographs made direct from the specimens by the author.]

Fig. 36. Anterior portion of the *operculum* of a teleosteon fish; outer aspect, nat. size. Species not determined.

Fig. 37. Imperfect fragment of the *operculum* of a teleosteon fish; outer aspect, nat. size. Species not determined.

Fig. 38. Anterior or articular extremity of the right *palatine* of a teleosteon fish; inner aspect, nat. size. Species not determined.

Fig. 39. Fragment of a bone of a teleosteon fish (part of *dentary ?*). Nat. size.

Figs. 40–42. Spines belonging to the skeleton of some vertebrate. Nat. size and not determined. Described in the text.

Fig. 43. *Maxillary* of right side of skull of a small teleosteon fish. Nat. size and almost perfect. Species not determined.

Fig. 44. Anterior or articular portion of the left *palatine* of a teleosteon fish. nat. size, outer aspect. Apparently same species as the one to which the bone belonged figured in Fig. 38, and an individual of the same size.

Figs. 45–48. *Maxillary bones* of teleosteon fishes. Apparently all from the same species, though different ages. Nat. size. Fig. 45 from right side of skull; Fig. 46, left; Fig. 47, left; all outer surface. Fig. 48, right, inner surface. In every instance the free lower portion is missing, while the heads or articular extremities are more or less perfect.

Fig. 49. Fragment of bone from a medium-sized teleosteon fish; apparently from the *frontal* of the left side, where it forms the roof of the orbit. Nat. size.

Fig. 50. Fragment from the *branchial arches* of a teleosteon fish, nat. size.

Figs. 51, 52. *Actinosts* (lowermost ones) from pectoral fin of a teleosteon fish. Nat. size. Species undetermined. Imperfect. Outer surfaces. Adults.

Fig. 53. Portion of the right ramus of the lower mandible, outer surface, of a grebe, probably *Æchmophorus occidentalis*, adult. Nat. size.

Fig. 54. Fragment of anterior portion of the *dentary*, left side, of a teleosteon fish. Species not determined. Nat. size.

Fig. 55. Anterior, articular portion of the *operculum* of the left side of the skull of a teleosteon fish. Outer aspect; nat. size. Species not determined.

Fig. 55.[1] Fragment of anterior portion of the *dentary*, right side, outer surface, of a teleosteon fish. Same species and same sized specimen as the one from which the bone in Fig. 54 came. Nat. size. Species not determined.

Fig. 56. Fragment of a bone from the skull of a teleosteon fish (part of frontal?). Nat. size.

Figs. 57–60. *Rays of pectoral fins* of teleosteon fishes, all natural size and probably of the same species,— the latter being not yet determined. Fig. 57, uppermost ray, left side, outer aspect. Fig. 58, uppermost ray, right side, inner aspect; Fig. 59, a ray from upper-mid-series; (anterior portion as in the case of the other three), lower surface. Fig. 60, uppermost ray, right side, inner aspect. The enlarged anterior ends form the articulations with the actinosts.

Figs. 61–64. Various *ribs* of a medium-sized Canid,— about the proportions of *Canis latrans*. Nat. size.

Fig. 65. External *metatarsal*, right foot of a Canid. (*Vulpes*, sp. ?) Very slightly reduced, extreme length of bone in the specimen 64 mm.

Fig. 66. Left *femur* of a small rodent (*Peromyscus*?). Condyles broken off. Very slightly reduced.

Fig. 67. *First metatarsal*, right side of a Canid (*Vulpes*, sp.?) In life, this bone measured in extreme length 68.5 mm. Outer aspect.

Plate XII.

Figs. 68–90. *Coracoids* of Grebes. Figs. 68 and 69 from right side, viewed on inner aspects. Figs. 70 to 83 inclusive, coracoids from left side, viewed on anterior aspects. Figs. 84–90 from right side, anterior views. All natural size. These coracoids belonged to specimens of *Æchmophorus occidentalis* and *Colymbus holbælli* of different ages and both sexes, a discussion of which is set forth in the text.

Plate XIII.

Figs. 91–101. *Humeri* of Grebes. Fig. 91, a perfect *humerus* of the existing form of *Æchmophorus occidentalis*, from a skeleton prepared by Cope and the author. Viewed upon anconal aspect. The extreme length of this bone, measured on the actual specimen, is 12.9 cms.

The humerus shown in Fig. 92 an anconal aspect, measures, in extreme length, 12.6 cms. A large part of the *ulnar crest* is broken off, otherwise the bone is quite perfect. It may have belonged to a female, or to a subadult individual of either sex of *Æchmophorus occidentalis*, or to an individual of *Colymbus holbœlli*. This likewise applies to the humerus shown in Fig. 93, also viewed on anconal aspect, and which measures in extreme length 12.4 cms. In it, both the radial and ulnar crests are slightly imperfect, otherwise the specimen is complete. It is of a lightish green color, instead of a dull black, as in the case of Fig. 92 and Figs. 94–101. Fig. 94, proximal two-thirds of humerus of *Æchmophorus occidentalis*, adult. Anconal aspect. Radial and ulnar crests somewhat chipped off.

Figs. 95 and 96, proximal parts of humeri of *Æchmophorus occidentalis*. Ulnar and radial crests chipped to some extent. Anconal aspects. Figs. 97 and 101 the same, but bones are smaller, and very probably belonged to *Colymbus holbœlli*. (adults). Figs. 97–100, distal portions of humeri seen on palmar aspects, very slightly chipped, otherwise perfect as far as they go. All three are of *Æchmophorus occidentalis*.

Plate XIV.

Fig. 102. Right *carpo-metacarpus* of *Botaurus lentiginosus*. Adult. Imperfect. Seen on palmar aspect, as are the bones shown in Figs. 103–110. These last are all *carpo-metacarpi* of Grebes.

Fig. 103. *Æchmophorus occidentalis*, adult, prepared by Cope and the author, and from the same skeletons as the bones figured on other Plates of the present paper (Fig. 91, Pl. XIII.). The extreme length of this specimen is 5.5 cms., or the same as the bones shown in Figs. 104–108 inclusive, which belonged to different individuals of *Æchmophorus occidentalis* (adults). Fig. 109 was from a female of the same species in all probability, and Fig. 110 of a specimen of *Colymbus holbœlli*, or perchance of a subadult *Æchmophorus occidentalis*.

Figs. 111–114. Anterior portions of *superior mandibles* of Grebes, seen upon superior aspects. They are slightly above natural size. Figs. 111, 112 are of *Æchmophorus occidentalis*, Fig. 111 having been collected by Condon. Figs. 113, 114 are probably from adult specimens of *Colymbus holbœlli*, or, what is less likely, from females or subadults of the Western Grebe.

Fig. 115. Skull of *Colymbus auritus* ♂. Natural size, superior aspect, lower mandible removed. (No. 17273, Coll. U. S. National Museum.) Shows the proportions of the superior mandible in this Horned Grebe as compared with the fossil ones seen in Figs. 111–114.

Figs. 116, 117. *Ulnæ* of Grebes,— Fig. 117 being from the pectoral limb of *Æchmophorus occidentalis* prepared by Cope and the author, which measures in extreme length 11.7 cms. Both are viewed upon anconal aspect, and the one shown in Fig. 116 measures in extreme length 10.1 cms., and probably belonged to an adult specimen of *Colymbus holbœlli*.

Figs. 118–124; 126. *Cervical vertebræ* of Grebes. Fig. 118, ventral view; Fig. 120, suboblique right lateral aspect; all of the remaining ones on direct dorsal views, and about natural size. These vertebræ probably belonged to several different individuals of *Æchmophorus occidentalis* of various ages and both sexes.

Fig. 127. Fragment of the frontal region of the *skull* of a grebe, probably *Colymbus holbœlli* (superior view). Anteriorly it is broken off just posterior to the lacrymals or about half a centimeter posterior to the transverse line seen at the distal end of the superior mandible shown in Fig. 113 of this Plate, which belonged to a bird of the same species and size. Compare with the frontal region of the skull in Fig. 115.

Fig. 128. Right lateral view of the coössified *sacral vertebræ* of the anterior two-thirds of the sacrum of a Grebe. Fragmentary and imperfect. There are many of these in the collection as well as the fused part of the dorsal division of the spinal column. They belonged to *Æchmophorus occidentalis* and *Colymbus holbœlli* of different ages and both sexes.

Plate XV.

Figs. 129–148. *Femora* of Grebes. All of natural size. Figs. 129–138, 145–148 (inclusive) are upon anterior view. Figs. 139–144 are upon posterior view. These bones belonged to specimens of *Æchmophorus occidentalis*, *Colymbus holbœlli* and probably other Grebes. Comments and descriptions of them are given fully in the text of the present paper. Figs. 129, 130 and 140 measure in extreme length 5 cms., and belonged to *Æchmophorus occidentalis* (adults). There are over 50 of such *femora* in the collection.

Plate XVI.

Fig. 149. Distal moiety of the left *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior aspect; very slightly reduced. From a fully adult individual.

Fig. 150. Distal moiety of the left *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior view; very slightly reduced. Osseous tendinal bridge broken out. Adult, though from a smaller bird than the one which furnished the *tibio-tarsus* shown in Fig. 149.

Fig. 151. Right *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior view; very slightly reduced and nearly perfect. From a subadult specimen.

Fig. 152. Left *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior aspect and slightly reduced. From a bird-of-the-year. Epiphyses not fully united; distal one missing.

Fig. 153. Left *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior view and somewhat imperfect. Slightly reduced. From either a ♀ or a subadult bird.

Fig. 154. Left *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior aspect and very slightly reduced. Quite perfect and belonged to a fully adult individual; probably a ♂. On the lower internal border of the cnemial process of this bone we find an elongated enlargement which is deeply excavated, posteriorly. This character is far more conspicuous than it is in the *tibio-tarsus* of the existing Grebe shown in Fig. 155 of this Plate.

Fig. 155. Left *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior aspect and very slightly reduced. Existing adult bird and probably a ♂. From a specimen prepared by Cope and the author. Extreme length 149.5 millimeters, the extreme length of the bone shown in Fig. 154 being 152.5 mm.

Plate XVII.

Fig. 156. Distal moiety of the right *tibio-tarsus* of *Æchmophorus occidentalis*. Adult, anterior aspect. All the figures on this Plate are very slightly reduced. Actual length of this fragment equals 92 mm. The figures in this Plate are designed to show the variations in size and character of this bone in these large Grebes as they occurred in the Pleistocene of Oregon.

Fig. 157. Distal end of right *tibio-tarsus* of *Æchmophorus occidentalis*. Anterior view. Reduction in size in same proportion as Fig. 156 above, and this applies to all the other figures in the Plate; for example, the portion of bone shown in Fig. 168 measures in length on the specimen 112.5 mm.; while in the Plate its length is 111.5 mm.

Figs. 158, 159, 160, 162 are distal portions of the *tibio-tarsus* of *Æchmophorus occidentalis*, anterior views. More or less imperfect. Adults, and probably both sexes. The bone shown in Fig. 160 belonged to an old ♂.

Figs. 161, 163–176. *Tibio-tarsi* of *Æchmophorus occidentalis*. Mostly direct anterior views, the only exceptions being Fig. 161, which is a right lateral view, and Figs. 167, 168 and 176, which are shown slightly turned to the right or left. They probably represent both sexes and subadults of various ages. They are all of the proximal end of the bone, and more or less imperfect, but show well the variation in the morphology of the enemial prolongation of this bone in the pelvic limb in different specimens. Compare with figures of Plate VIII to determine rights and lefts. Fig. 161 shows the pit on the enemial process described in Plate VIII.

Plate XVIII.

(*Tarso-metatarsi* of Grebes, all seen upon anterior aspect with the exception of Fig. 190, which is given upon right lateral view. Designed to show the variation of this bone of the pelvic limb for *species*, *time*, *sex*, and *age*. All are nearly natural size.)

Figs. 177–180. Show very well the variations in lengths and other proportions of the *tarso-metatarsus* of the *larger* species of these Grebes. These, and other matters are fully discussed in the text.

Fig. 181. *Tarso-metatarsus* of a recent specimen of *Æchmophorus occidentalis* prepared by Cope and the author. The actual length of this bone, measured from the highest point on the enemial process to the lowest point on the mid-trochlea distally, equals 79 mm. Of all those here figured, this bone best agrees with the one in Fig. 187; while all the others are, in one particular or another, more or less different from it.

Fig. 182. This is a *tarso-metatarsus* which corresponds in every particular — even including its imperfections — with the *tarso-metarsus* described by Mr. L. H. Miller as belonging to *Æchmophorus lucasi*,— a matter which is discussed in the text of the present paper.

Fig. 183. Photographic reproduction of the drawing of the *tarso-metatarsus* of a Grebe by Mr. L. H. Miller, of the species named by him, *Æchmophorus lucasi*. Taken the size of the original on the same negative with the other bones on this Plate.

Figs. 184–190. *Tarso-metatarsi* of Grebes. (Descriptions given in the text.) These bones should be compared with Figs. 9, 10, and 14 of Plate I, and with Figs. 33–35 of Plate II of this paper.

Plate XIX.

Figs. 191, 191a–1″, 257, 258. *Pedal joints* of various species of birds of the fossil fauna of the Oregon Desert. All natural size, and viewed upon dorsal aspect. There are here represented grebes, ducks, geese, swans, limicoline species, diurnal raptores, owls, etc., the *correct* references for which can only be made by comparing with the bones of a great many existing species, only a few of which are now to be found in museum collections. Some can be easily determined; others will require great care and abundant material for comparison.

Fig. 257 is the basal phalanx of the mid-anterior toe of an adult individual of the extinct swan, *Olor paloregonus* Cope.

Fig. 258 may be the corresponding bone of a very young bird of the same species, and probably is. The short, *thick* bones usually belong to falconine species or to owls.

Plate XX.

Fig. 259. Right lateral view of the *skull* (with lower mandible attached), occipital style; and the atlas and axis vertebræ of *Phalacrocorax auritus* (No. 19262, Coll. U. S. National Museum). Slightly reduced,— the extreme length of the *occipital style* in the specimen measures 25 mm.

Fig. 260. Proximal extremity of the right ramus of the mandible of *Phalacrocorax macropus* Cope. Slightly reduced; lateral aspect.

Fig. 262. Superior mandible of *Phalacrocorax macropus* Cope, vertically divided, mid-longitudinally, showing the inner structure on lateral aspect. This fragment is of the left side of the upper mandible.

Plate XXI.

[Fossil bones of the extinct Cormorant *Phalacrocorax macropus* Cope, all natural size.]

Fig. 262. Proximal moiety of the left *carpo-metacarpus*. Adult. Somewhat imperfect.

Fig. 263. Left *carpo-metacarpus;* adult. Imperfect.

Fig. 264. Right *carpo-metacarpus;* adult. Imperfect.

Fig. 265. Twelfth *cervical vertebra*, viewed upon oblique left lateral aspect. Adult, and almost perfect.

Fig. 266. Ninth *cervical vertebra*, viewed upon almost direct left lateral aspect. Adult. Imperfect.

Fig. 267. Eighth *cervival vertebra*, viewed upon direct left lateral aspect. Subadult.

Fig. 268. *Proximal phalanx* of index digit; palmar view. Adult, and very nearly perfect.

Fig. 269. Distal end of right *ulna*. Superior surface. Adult.

Fig. 270. Superior extremity of the right *coracoid*. Mesial aspect. Subadult. Imperfect.

Fig. 271. Sternal extremity of right *coracoid*. Anterior aspect. Subadult Imperfect. Unites accurately with the portion figured, shown in Fig. 270.

Fig. 272. Right *coracoid*, anterior aspect. From an adult bird. Process at infero-external angle broken off and lost, otherwise almost perfect.

Fig. 273. Upper extremity of right *coracoid*. Adult. Mesial aspect. Imperfect.

Fig. 274. Left *coracoid*, anterior aspect. Adult. Imperfect. All of these coracoids have the process at the outer sternal angle broken off,— a part of the bone which is very thin and fragile.

Fig. 275. Distal portion of the right *humerus:* palmar aspect. From an adult specimen. Quite perfect as far as it goes. The characters at this extremity of the humerus are almost identical with the corresponding ones in *P. auritus*.

Plate XXII.

[*Tarso-metatarsi* of *Phalacrocorax macropus* Cope. All viewed upon anterior aspect and natural size.

Fig. 276. Distal moiety of the bone. From a female, or a subadult bird.

Fig. 277. Distal moiety of the bone. Adult. Very nearly perfect as far as it goes.

Fig. 278. The bone as it appears when very nearly perfect; from a specimen fully adult, and probably a male.

Figs. 279–281. Bones from subadult individuals, each somewhat imperfect,— though the one shown in Fig. 279 is practically perfect.

Figs. 282, 283. Each slightly shorter than the bone as seen in Fig. 278 (♀ ♀?). The specimen shown in Fig. 282 exhibits peculiar excoriations; while the one seen in Fig. 283 is almost perfect.

Plate XXIII.

Fig. 284. Distal extremity of the left *tibio-tarsus* of *Phalacrocorax macropus*, Cope. Viewed on mesial aspect. Imperfect. Adult. Very slightly reduced.

Fig. 285. Proximal extremity of the left *tibio-tarsus* of *Phalacrocorax macropus*, Cope. Viewed on mesial aspect. Imperfect. Adult. Same amount of reduction as in Fig. 284, and all the other figures on this Plate.

Fig. 286. Left *pectoral limb* of a specimen of *Phalacrocorax auritus*. From an adult. (No. 19262, Coll. U. S. National Museum.) Complete and showing same amount of reduction. Viewed on mesial aspect. Extreme length of *tibio-tarsus* equals 107 mm. in this specimen of the existing species.

Fig. 287. Left *femur* of *Phalacrocorax macropus* Cope. Mesial aspect. The outer longitudinal half of this bone lost, and the specimen is otherwise imperfect. Adult. The actual length of this bone equals 70 mm., while the length of the femur in *P. auritus* (Fig. 286) equals 56 mm.

Fig. 288. Left *tarso-metatarsus* of a specimen of *Phalacrocorax macropus* Cope. Mesial aspect. Same bone as the one shown on anterior view in Fig. 278 of Plate XXII. Possibly the bones shown in Figs. 284, 285, 287 and 288 may have belonged to the same individual — or perhaps to two individuals; but it is not in the least probable that they did.

Plate XXIV.

Fig. 289. Proximal moiety of the right *humerus* of *Chen hyperboreus;* anconal aspect. Somewhat imperfect. Natural size. Adult.

Fig. 290. Anconal aspect of the right *humerus* of a specimen of *Anser albifrons gambeli.* Imperfect. Natural size. Adult.

Fig. 291. Anconal aspect of the left *carpo-metacarpus* of a specimen of *Anser albifrons gambeli.* Natural size. Imperfect. Adult.

Fig. 292. Anconal aspect of the left *carpo-metacarpus* of a specimen of *Chen hyperboreus.* Natural size. Imperfect. Adult.

Fig. 293. Anterior aspect of the left *coracoid* of a specimen of *Anser albifrons gambeli.* Adult. Natural size. Imperfect.

Fig. 294. Anterior aspect of the left coracoid of a specimen of *Chen hyperboreus.* Adult. Natural size. Imperfect.

Fig. 295. Anterior aspect of the left *tarso-metatarsus* of a specimen of *Anser albifrons gambeli.* Adult. Natural size. Imperfect.

Fig. 296. Anterior aspect of the right *tarso-metatarsus* of a specimen of *Chen hyperboreus.* Adult. Natural size, very nearly perfect.

Plate XXV.

Fig. 297. Anconal aspect of the left *carpo-metacarpus* of a specimen of *Chen hyperboreus.* Slightly reduced. Imperfect. Adult. Same bone as shown in Fig. 292 of Plate XXIV, and here reproduced for the purpose of comparison with other *carpo-metacarpi.* (Fossil.)

Fig. 298. Palmar aspect of the left *carpo-metacarpus* of a specimen of *Branta hypsibata* (Cope). Slightly reduced. Imperfect. Adult. (Fossil.)

Fig. 299. Palmar aspect of the right *carpo-metacarpus* of a specimen of *Branta hypsibata* (Cope). Slightly reduced. Imperfect. Adult.

Fig. 300. Anconal aspect of the right *carpo-metacarpus* of a specimen of *Chen hyperboreus.* Slightly reduced. Imperfect. Adult. (Fossil.)

Fig. 301. Anconal aspect of the left *carpo-metacarpus* of *Chen caerulescens* (No. 18613. Coll. U. S. National Museum). Adult. Same amount of reduction as in other figures of this Plate. Length 86 mm.

Fig. 302. Anconal aspect of left *carpo-metacarpus* of a specimen of *Chen hyperboreus nivalis.* (No. 18611, Coll. U. S. National Museum). Adult. Slightly reduced. Length of this bone equals 89 mm.

Fig. 303. Anconal aspect of the left *carpo-metacarpus* of a specimen of *Anser albifrons gambeli.* Adult. Imperfect. Slightly reduced. (Fossil.)

Fig. 304. Anconal aspect of the right *carpo-metacarpus* of a specimen of *Branta canadensis* (No. 17980, Coll. U. S. National Museum). Adult. Slightly reduced. Length of this bone equals 106 mm. The bone from a fossil specimen is shown in Fig. 305.

Fig. 305. Anconal aspect of the right *carpo-metacarpus* of a specimen of *Branta canadensis.* (Cope collection.) Adult. Perfect. Slightly reduced. Length of this bone equals 107 mm. Note the ossified excrescence on the apex of the pollex metacarpal, present in both the existing and fossil bird.

Plate XXVI.

Figs. 306, 307. Anterior moieties of *scapulæ* of *Chen caerulescens*. Dorsal aspect. Natural size. Adults. Compare with Figures 311, 312, and note pneumatic foramen at distal end.

Fig. 308. Anterior extremity of the right *scapula* of *Chen h. nivalis*, seen upon dorsal aspect. Perfect as far as it goes. Adult. Natural size. (Fossil.)

Fig. 309. Anterior extremity of the right *scapula* of *Olor matthewi* (sp. n.). Dorsal aspect, and apparently belonged to an adult specimen. Natural size.

Fig. 310. Anterior two-thirds of the right *scapula* of *Olor paloregonus* Cope. Adult. Dorsal surface. Natural size.

Fig. 311. Right *scapula* of a specimen of *Chen h. nivalis* (No. 18611. Coll. U. S. National Museum). Dorsal aspect; natural size; adult.

Fig 312. Right *scapula* of *Chen caerulescens* (No. 18613, Coll. U. S. National Museum). Dorsal surface, Natural size. Adult.

Fig 313. (Not used).

Fig. 314. Anterior end of the right *scapula* of *Chen h. nivalis*. Dorsal aspect. Adult and natural size.

Fig. 315. *Proximal phalanx* of the *index digit* of the right pectoral limb of *Olor buccinator*. Anconal aspect. Adult, natural size. (No. 18509, Coll. U. S. National Museum.)

Fig. 316. *Proximal phalanx* of the *index digit* of the right pectoral limb of *Olor paloregonus* Cope. Anconal aspect. Adult; natural size.

Fig. 317. Proximal moiety of *ulna* of left pectoral limb of a specimen of *Olor buccinator*. Anconal aspect; natural size. Adult. The distal half of this bone is in the collection. Full description in the text. (Fossil.)

Fig. 318. Proximal moiety of *ulna* of an adult specimen of *Olor buccinator* in the Collections of the U. S. National Museum. (No. 18509.) Adult. Natural size. Viewed on anconal aspect, as in the case of the ulna figured in the preceding figure.

Plate XXVII.

[Fossil bones of *Branta hypsibata* Cope, with some parts of lower mandibles of anserine birds. All exhibit the same amount of reduction, which is very slight.]

Fig. 319. Right *tarso-metatarsus*. Anterior aspect. (See notes under next figure).

Fig. 320. Right *tarso-metatarsus*, anterior aspect. (Cope's *type*.) This bone is considerably stouter and a trifle longer than the one shown in Fig. 319, which latter belonged to some other species of *Branta* of the *Branta canadensis* order. This matter is taken up in the text. Both bones have the hypotarsus broken off, otherwise they are nearly perfect.

Fig. 321. *Proximal phalanx* of index digit, left pectoral limb, seen on anconal aspect. Adult, and only slightly imperfect.

Fig. 322. Free extremity of the left limb of the *os furcula*, seen on outer aspect. Adult, imperfect.

Fig. 323. Left *humerus*, palmar aspect. Adult. Head of the bone gone, and otherwise somewhat imperfect.

Figs. 324, 326, 327. Posterior and middle portion of the ramus of three anserine birds. Outer aspects. All apparently from adult birds. Their characters fully described in the text. (Fig. 325 omitted.)

Fig. 328. Anterior end of a left *scapula*. Adult. Imperfect. Viewed upon dorsal aspect.

Fig. 329. Head of *humerus* of a specimen of *Branta hypsibata* Cope. Right pectoral limb. Adult. Imperfect.

Fig. 330. Right *coracoid*, anterior view. Adult. Somewhat imperfect.

Fig 331. *Basal phalanx* of left foot of a goose, and possibly belonged to a *Branta hypsibata*. Dorsal view. Adult and nearly perfect.

Fig. 332. Distal third of the *tibio-tarsus* of a *B. hypsibata* Cope. Adult. Anterior view. Imperfect.

Plate XXVIII.

[Fossil bones of various specimens of *Branta canadensis* (Cope collection). All adult and very slightly reduced. References by the author, and carefully compared with the corresponding bones of a specimen in the Collections of the U. S. National Museum. (No. 17980.)]

Fig. 333. Proximal moiety of *carpo-metacarpus;* right pectoral limb. Anconal aspect. Imperfect.

Fig. 334. *Carpo-metacarpus;* right pectoral limb. Anconal aspect. Imperfect. Note fossilized exostosis on end of pollex metacarpal. This specimen is practically perfect.

Fig. 335. Head of *humerus* of right pectoral limb. Anconal aspect.

Fig. 336. Head of *coracoid*. Right side. Quite perfect as far as it goes. Posterior view.

Fig. 337. Anterior portion of a left *scapula*. Dorsal surface. Slightly chipped.

Fig. 338. Forepart of a *sternum*, anterior view, showing "coracoidal grooves." Adult; imperfect.

Fig. 339. Distal extremity of a right *humerus*. Palmar aspect. Surfaces of articular trochlæ abraded.

Fig. 340. Distal moiety of a right *tarso-metatarsus*, anterior view. Imperfect. (Margins of trochlæ abraded.)

Fig. 341. Anterior view of an imperfect, left *coracoid*. Adult.

Fig. 342. *Basal phalanx* of mid-anterior toe of the left foot of a *Branta canadensis* (fossil). Dorsal view. Adult.

Fig. 343. Proximal extremity of a right *tarso-metatarsus*, seen on anterior view. Imperfect.

Fig. 344. Anterior view of the fore part of a *sternum*, showing coracoidal grooves and part of carina. Adult. Imperfect.

Figs. 345, 346. *Proximal phalanges* of index digits of left pectoral limbs. Palmar aspects. Very slightly reduced and almost perfect,— two minute chippings only occur on the bone shown in Fig. 346.

Plate XXIX.

[Exhibiting fossil bones of the extinct goose, *Branta propinqua* Shuf. All adult and natural size. (Cope collection.) Bones show slight chipping at some of the angles and margins, otherwise quite perfect, except in cases where only part of the bone is present, as in Figs. 347, 354, 355, 356, 358 etc.]

Fig. 347. Right limb and loop of *os furcula*, viewed upon mesial aspect. The left clavicle is broken off just beyond the arch.

Fig. 348. Anterior moiety of a left *scapula;* dorsal surface.

Fig. 349. Left *ulna;* suboblique view of anconal surface. Length of specimen 95 mm.

Fig. 350. Left *humerus*. Adult, and almost perfect bone.

Fig. 351. *Proximal phalanx, index digit*, right pectoral limb,— viewed upon palmar aspect.

Fig. 352. A right *coracoid;* anterior surface. Adult.

Fig. 353. A left *coracoid;* anterior surface. Adult. It is not at all likely that these two coracoids belonged to the same individual.

Figs. 354, 355. Two *metacarpals*, left pectoral limbs. Adults. Imperfect.

Fig. 356. *Tarso-metatarsus*, right pelvic limb. Head of the bone broken off. Anterior view. Adult.

Fig. 357. Left *tarso-metatarsus*, anterior view; adult. Imperfect.

Fig. 358. Costal border of *sternum*. Outer aspect. Adult. Imperfect.

Fig. 359. A right *femur*, seen upon anterior aspect. Adult. Natural size. Apart from two or three insignificant chippings, this bone is quite perfect.

Plate XXX.

Figs. 360–363. *Histrionicus histrionicus*. Fig. 360 (fossil) right *coracoid*, anterior view; adult. Natural size. Imperfect. Fig. 361 is the right *coracoid* of a specimen of this duck in the Coll. U. S. National Museum (No. 223756). Natural size. Fig. 362 proximal portion of a right *humerus*, anconal aspect; slightly chipped. Natural size; adult. Fig. 363 proximal portion of right *humerus* (existing birds), No. 223756, Coll. U. S. National Museum. Adult. Natural size.

Figs. 364, 365. *Mergus serrator*. Adults. Natural size. Fig. 364 (fossil) proximal moiety of a right *femur;* anterior view. Fig. 365 right *femur* of *Mergus serrator* in Coll. U. S. Nat. Museum (No. 16626).

Figs. 366–369 are of *Charitonetta albeola*. Adults. Natural size. Fig. 366 (fossil) proximal end of a right *humerus*, anconal aspect (slightly chipped). Fig. 367. Proximal end, right *humerus*, anconal view, of *Charitonetta albeola* (existing). No. 16627, Coll. U. S. National Museum. Figs. 368 (existing), 369 (fossil) *carpo-metacarpi* of left limbs; both perfect and characters identical.

Figs. 370, 371, 374, 379, 380 and 381 are all of Steller's Eider (*Polysticta stelleri*). Adults and natural size. Fig. 370 (fossil) proximal extremity of a right *humerus*, anconal aspect. Fig. 371, right *humerus*, anconal side (No. 15272, Coll. U. S. National Museum). Fig. 374 (fossil) anconal aspect of a *carpo-metacarpus*, right pectoral limb. Fig. 379, anterior view of a left *coracoid* (fossil), practically perfect. Fig. 380, anterior view of a left *femur* (fossil), slightly chipped. This reference is

only provisional, as I am much in doubt that this femur belonged to a specimen of *Polysticta stelleri*, for, while it agrees very closely in some essential characters with the bone shown in Fig. 381 (*Polysticta stelleri*, No. 15272, Coll. U. S. National Museum), it departs from it in other particulars, as the lack of curvature in the shaft, and the smaller *caput femoris*.

Figs. 372, 373, 375–378. Fossil and existing Canvas-back Ducks (*Marila valisineria*). Adults. Natural size. Fig. 372 (fossil) a *carpo-metacarpus* of a left pectoral limb, seen upon anconal aspect. Fig. 373 (existing) *carpo-metacarpus*, right pectoral limb. (No. 16245, Coll. U. S. National Museum.) Fig. 375 (fossil), right *femur*, anterior aspect (slightly chipped). Fig. 376 (existing), No. 16245, Coll. U. S. National Museum, right *femur*, anterior aspect. Fig. 377 (fossil), fragment of a right *tarso-metatarsus*, exhibiting all the distinctive characters, as far as they go, of this bone in the Canvas-back. Fig. 378 *tarso-metatarsus* an *fibula* of a specimen of *Marila valisineria* (No. 16245, Coll. U. S. National Museum). Figs. 377, 378 are both anterior views from adults, and natural size.

Plate XXXI.

Fig. 382. Fossil right *humerus*, anconal aspect. Adult. Natural size. Belonged to a *Querquedula* and probably *Q. cyanoptera*.

Fig. 383. Right limb of fossil *os furcula*, outer aspect. Adult. Natural size. Belonged to a goose, apparently of the genus *Chen*.

Figs. 384, 385. *Coracoids* of Redhead (*Marila americana?*) Adults. Natural size. Each from right side and on anterior view. Fig. 384 (existing) is from skeleton No. 17619, Coll. U. S. National Museum. Fig. 385 (fossil) has lower external angle broken off, but is otherwise quite perfect.

Figs. 386, 387. *Ulnæ* of Mallards. (*Anas platyrhynchos.*) Adults. Natural size. Fig. 386 (fossil) right *ulna*, anconal aspect. Very nearly perfect. Fig. 387 (existing) left *ulna*, anconal surface. (No. 18598. Coll. U. S. National Museum).

Figs. 388, 389, 392, 393. Bones, fossil and recent, of *Marila affinis*. Fig. 388 fossil *ulna* from left pectoral limb; inferior surface. Adult; natural size. Very slightly chipped. Fig. 389, left *ulna* (same surface etc.) of a recent individual (No. 18605, Coll. U. S. National Museum); natural size. The fossil *ulna* is somewhat stouter than the one shown in Fig. 389; but otherwise the bones agree well. It is quite possible that this fossil bone may have belonged to a *M. marila* or a *M. collaris*. Figs. 392 and 393 are right *coracoids* seen upon anterior view. The one in Fig. 392 (fossil) is almost perfect,— the small process at the lower outer angle having been broken off. Fig. 393 (existing) is from the skeleton in the U. S. National Museum collection (18605).

Figs. 390, 391, 394–397 are bones from fossil and recent skeletons of the Ruddy Duck (*Erismatura jamaicensis*). Figs. 390, 391 *coracoids* (left sides); anterior views, natural size. Fig. 390 (fossil) somewhat imperfect. Fig. 391 is from a skeleton in the Collection of the U. S. National Museum (No. 11220), as is also the *tarso-metatarsus* seen in Fig. 395, and the *femur* in Fig. 396. The fossil *tarso-metatarsus* shown in Fig. 395 is from a right pelvic limb and seen on anterior view. Almost perfect; adult; natural size. The *femora* are shown upon anterior views, and each is from a right pelvic limb. Fig. 397 (fossil) agrees very closely with the *femur* of the bone of the recent bird.

Fig. 398. *Femur.* Anterior view. Adult. Natural size. Condyles broken off and otherwise imperfect. This fossil bone is from a species of *Mergus*, somewhat larger than *Mergus americanus*.

Plate XXXII.

Fig. 399. Free end of a clavicle (*os furcula*) of a large bird. Adult. Natural size.

Figs. 400–402, 404. *Coracoids* of *Branta bernicla*. Adults. Natural size. Fig. 400, mesial aspect. Fig. 401, posterior surface. Figs. 402 and 404 anterior aspects. Fig. 400 is a left coracoid, and the other three are rights.

Fig. 403. Right *carpo-metacarpus* of an anserine bird (fossil). Adult and natural size. Viewed upon anconal aspect. This bone agrees with the corresponding one in the recent *Mergus americanus*, but is shorter. It is very probable that it belonged to a ♀ of that species, as the ♀ is much smaller than the ♂, and doubtless was in Pleistocene time.

Fig. 405. Part of the *cranial vault* of a fossil bird, viewed upon its internal aspect. Adult. Natural size. It appears to be *cormorant*, and probably *Phalacrocorax macropus* Cope.

Figs. 406, 407. Fossil *carpo-metacarpi* of *Clangula islandica*. Adults. Natural size. Imperfect. Fig. 406 from the right wing, seen on anconal aspect; and Fig. 407 from the left wing and viewed upon palmar aspect.

Fig. 408. Right *femur* of *Anser albifrons gambeli* (fossil). Anterior view. Adult. Natural size. Very slightly chipped. For other bones of this goose, see Plates XXIV and XVII.

Fig. 409. Right *coracoid* of *Anser albifrons gambeli* (fossil). Adult. Anterior view. Natural size. Imperfect.

Fig. 410. Left *coracoid* of *Anser albifrons gambeli* (fossil). Adult. Posterior view. Natural size. Imperfect.

Fig. 411. Proximal moiety of a right *carpo-metacarpus* (fossil) of a specimen of *Anser albifrons gambeli*. Adult. Palmar aspect. Natural size. Compare with additional figure in Plate XXV.

Plate XXXIII.

Fig. 412. Left *tibio-tarsus* of a *Branta* (fossil). Adult. Natural size. Very slightly chipped. Anterior aspect. Extreme length 148 mm. The fibula was lost. Probably *Branta canadensis*.

Fig. 413. Left *tarso-metatarsus* and *fibula* of *Branta canadensis*. (No. 17980, Coll. U. S. National Museum.) Adult. Natural size. Anterior aspect. Length 161 mm. Presented for the purpose of comparing it with the bone shown in Fig. 412.

Fig. 414. Distal moiety of the left *humerus* of a *Branta* (fossil). Adult. Natural size. Palmar aspect. From a smaller goose than *B. canadensis*, and probably belonged to a specimen of a *Branta c. hutchinsi*.

Fig. 415. Left *humerus* of *Branta canadensis*. Palmar aspect; natural size. (No. 17980, Coll. U. S. National Museum.) Presented for the purpose of comparing it with the bone shown in Fig. 414.

Plate XXXIV.

(Right *coracoids* of fossil and existing Anserines. Adults. Very slightly reduced. Anterior views.)

Fig. 416. *Coracoid* of *Chen cærulescens* (No. 18613, Coll. U. S. National Museum).
Fig. 417. *Coracoid* of *Chen hyperboreus nivalis* (No. 18611, Coll. U. S. National Museum).
Fig. 418. *Coracoid* of *Branta canadensis.* (No. 17890, Coll. U. S. National Museum).
Fig. 419. *Coracoid* of *Olor buccinator.* (No. 18509, Coll. U. S. National Museum).
Fig. 420. *Coracoid* of *Olor paloregonus*, Cope. (Extinct.)

Plate XXXV.

Fig. 421. Right *carpo-metacarpus* of *Olor palorcgonus* Cope (extinct). Adult. Natural size. Imperfect.
Fig. 422. Left *carpo-metacarpus* of *Olor matthewi*, n. sp. (extinct). Adult. Natural size. Quite perfect. Exostosis on summit of pollex metacarpal is of a pathological nature and fossilized.
Fig. 423. Left *carpo-metacarpus* of *Olor buccinator.* (No. 18509, Coll. U. S. National Museum.) Adult. Natural size.
Fig. 424. Nineteenth *cervical vertebra* of *Olor buccinator.* Dorsal aspect. Natural size. (No. 18509, Coll. U. S. National Museum.)
Fig. 425. Nineteenth *cervical vertebra* of *Olor paloregonus* Cope (extinct). Natural size. Dorsal aspect. Imperfect.

Plate XXXVI.

(*Femora* of fossil and existing Anserines. Adults. Very slightly reduced. Anterior views. Adults.)

Fig. 426. *Femur* of *Chen cærulescens* (No. 18613, Coll. U. S. National Museum).
Fig. 427. *Femur* of *Chen hyperborcus nivalis.* (No. 18611, Coll. U. S. National Museum.)
Fig. 428. *Femur* of *Branta canadensis.* (No. 17980, Coll. U. S. National Museum.)
Fig. 429. *Femur* of *Olor americanus.* (No. 18571, Coll. U. S. National Museum.)
Fig. 430. *Femur* of *Olor buccinator.* (No. 18509, Coll. U. S. National Museum.)
Fig. 431. *Femur* of *Olor palorcgonus* Cope. (Extinct). Extreme length of this bone equals 109 mm. Imperfect.

Plate XXXVII.

(*Tarso-metatarsi* of fossil and existing Anserines. Adults. Reduced. Anterior views. From both right and left pelvic limbs.)

Fig. 432. *Tarso-metatarsi* of a large existing Swan (*Olor*). Left pelvic limb. From the collection of Professor Cope, now belonging to American Museum of Natural History. Not identified. Much longer than the longest *tarso-metatarsus* of any of those belonging to existing Swans in the Collections of the U. S. National Museum. For description, see text. This bone measures in extreme length 123.5 mm.

Fig. 433. *Tarso-metatarsus* of a specimen of *Olor buccinator*. Left pelvic limb. From collection of Professor Cope and now the property of the American Museum of Natural History. Measures in extreme length 112 mm.

Fig. 434. Right *tarso-metatarsus* of *Olor buccinator*. (Coll. U. S. Nat. Mus. No. 18509.) Extreme length 114 mm.

Fig. 435. Left *tarso-metatarsus* (fossil) of a specimen of *Olor buccinator*. Almost perfect. Extreme length equals 114 mm.

Fig. 436. Right *tarso-metatarsus* (fossil) of a specimen of *Olor buccinator*. Imperfect with respect to loss of hypotarsus and margins of the trochleæ. Extreme length 113.5 mm.

Fig. 437. Right *tarso-metatarsus* of a specimen of *Olor americanus* (Coll. U. S. Nat. Mus. No. 18571). (Recent.) Extreme length equals 103.5 mm.

Fig. 438. Left *tarso-metatarsus* (fossil) of a specimen of *Olor americanus*. Distal trochleæ all broken off, and border of summit chipped. Straight line from highest point on the intercondylar tuberosity to the lowest point in the periphery of the foramen below for the anterior tibial artery measures 88.5 mm. The same line on the *tarso-metatarsus* shown in Fig. 437, measures 87 mm.

Plate XXXVIII.

Fig. 439. Left *tarso-metatarsus* of a specimen of *Podilymbus magnus* (n. sp.) (fossil). Adult. Reduced. Anterior view. Quite perfect. Length 44 mm.

Fig. 440. Left *tarso-metatarsus* of a specimen of *Podilymbus magnus* (n. sp.) (fossil). Adult. Reduced.

Fig. 441. Right *tarso-metatarsus* of a specimen of *Colymbus auritus*. (Coll. U. S. Nat. Mus. No. 17273.) Adult; anterior view; reduced. Length 45.5 mm.

Fig. 442. Right *humerus* of a specimen of *Colymbus n. californicus*. Adult. Somewhat reduced. Anconal aspect. Practically perfect. Extreme length 68 mm.

Fig. 443. Proximal three-fourths of a right *humerus* of *Colymbus n. californicus*. Somewhat reduced. Palmar aspect.

Fig. 444. Left *tarso-metatarsus* of a specimen of *Colymbus n. californicus*, anterior aspect. Adult ♂ ?. Somewhat imperfect. Extreme length of bone equals 42 mm.

Fig. 445. Left *tarso-metatarsus* of a specimen of *Colymbus n. californicus*, nearly perfect, and anterior aspect. Probably belonged to a female or subadult individual. Length equals 39 mm.

Fig. 446. Right *femur* of a specimen of *Colymbus n. californicus*. Very slightly chipped. Posterior aspect. Adult. Length 29 mm.

Fig. 447. Left *femur* of a specimen of *Colymbus n. californicus*. Somewhat imperfect. Anterior aspect. Adult. (♂ ?) Length 32 mm.

Fig. 448. Left *coracoid* of a specimen of *Colymbus auritus*. (Coll. U. S. Nat. Mus. No. 17273.) See description under Fig. 441 of the Plate. Anterior aspect. Extreme height of bone 31 mm.

Fig. 488. Right *tibio-tarsus* and *fibula* of a specimen of *Aquila chrysaëtos*. (Coll. U. S. Nat. Mus. No. 18802.) Slightly enlarged. Adult. Anterior aspect. Bones of Fig. 493 belong to the same skeleton. Length 165.5 mm.

Fig. 489. *Claw of Aquila chrysaëtos*, outside toe, left foot. Adult. Slightly enlarged. Mesial aspect. (Coll. U. S. Nat. Mus. No. 18194.) Phalanx shown in Fig. 491 belongs to the same skeleton.

Fig. 490. Proximal two-thirds of the *claw* of the outside toe of the left foot (fossil) of *Aquila chrysaëtos*. Mesial aspect. Adult. Apex broken off.

Fig. 491. *Distal phalanx* of *middle toe* of left foot of *Aquila chrysaëtos*. Dorsal aspect. Adult. Slightly enlarged. This is the joint next posterior to the claw of the toe to which it belongs. (Coll. U. S. Nat. Mus. No. 18194.)

Fig. 492. *Distal phalanx* of *middle toe* of left foot of *Aquila chrysaëtos* (fossil). Adult. Dorsal aspect. Slightly enlarged. This is the joint next posterior to the claw of the toe to which it belongs.

Fig. 493. Right *carpo-metacarpus* and first or *proximal phalanx of index digit* of *Aquila chrysaëtos*. (Coll. U. S. Nat. Mus. No. 18802.) Adult. Slightly enlarged. Palmar aspect. Introduced in that the phalanx of the index digit may be compared with the corresponding bone from the skeleton of a White-headed Eagle (Fig. 494). Both viewed on palmar aspect. The difference in their morphology is apparent at a glance.

Fig. 494. *Proximal phalanx* of *index digit* of right manus of *Haliæetus leucocephalus*. (Coll. U. S. Nat. Mus. No. 19384.) Adult. Palmar aspect. Slightly enlarged (half a millimetre). Length equals 41.5 mm.

Fig. 495. Distal extremity of the right *tibio-tarsus* of a specimen of the Golden Eagle (*Aquila chrysaëtos*, fossil). Adult. Anterior aspect. Very slightly enlarged (5 mm. transcondylar diameter). Imperfect. Compare with the same portion of bone in Fig. 488.

Fig. 496. *Proximal phalanx of the index digit* of the right manus of a specimen of the White-headed Eagle (*Haliæetus leucocephalus*, fossil). Adult; palmar aspect; somewhat imperfect. Compare with bone shown in Fig. 494. Almost natural size.

Plate XLI.

(Fossil bones from the Oregon Desert representing the Sage Cock (*Centrocercus urophasianus*). Adults of both sexes. More or less imperfect. All natural size. Figs. 498, 500, 502, 508 and 509 are from the Collections of the U. S. National Museum and from skeletons of recent individuals.)

Fig. 497. Left *tarso-metatarsus;* anterior aspect.

Fig. 498. Left *tarso-metatarsus;* anterior aspect. (Coll. U. S. Nat. Mus. No. 17975 ♀.)

Fig. 499. Right *tarso-metatarsus;* posterior aspect.

Fig. 500. Right *tarso-metatarsus*, anterior aspect. (Coll. U. S. Nat. Mus. No. 17975 ♀.) (Through an oversight, this bone was photographed on *anterior* aspect instead of posterior, in order to compare it with that view in Fig. 499. It may be said, however, that the two bones are practically identical in all particulars.)

Fig. 501. Left *carpo-metacarpus;* palmar aspect; (fossil). Perfect.

Fig. 502. Right *carpo-metacarpus;* palmar aspect. (Coll. U. S. Nat. Mus. No. 17975 ♀.)

Fig. 503. Proximal portion of the right *carpo-metacarpus;* anconal aspect. (Fossil.) From the skeleton of a large male.

Fig. 504. Proximal portion of the right *carpo-metacarpus;* anconal aspect. (Fossil). Apparently from a female not fully adult. Compare with Fig. 501.

Fig. 505. Proximal extremity of the right *tarso-metatarsus;* anterior aspect. Belonged to a skeleton of an old male Sage Cock.

Fig. 506. Distal portion of the left *femur;* anterior aspect. Old male.

Fig. 507. Sternal extremity of a right *coracoid;* (fossil); anterior aspect. Adult female. Perfect as far as it goes.

Figs. 508, 509. *Coracoids* from the skeleton of a female *Centrocercus urophasianus.* (Coll. U. S. Nat. Mus. No. 17975.) Fig. 508 from right side, anterior aspect; large shot-hole through its sternal extremity. Fig. 509 left side, posterior aspect. The fossil bone shown in Figure 507 belonged to a female Sage Cock of exactly the same size as the bird which furnished the *coracoids* shown in Figs. 508, 509.

Fig. 510. Proximal end of a right *ulna;* anconal view. From the skeleton of an old male (fossil).

Fig. 511. Anterior portion of a pelvic *sacrum.* Ventral aspect (fossil). From the skeleton of an old male. Imperfect.

Fig. 512. Proximal end of a right *tibio-tarsus.* Anterior aspect. Female. Imperfect.

Fig. 513. Head of a left *coracoid.* Posterior aspect. (Fossil.) From the skeleton of a very large male Sage Cock. Compare with bone shown in Fig. 509 of this Plate.

Fig. 514. Squamosal portion of the skull. Left side, external aspect. Medium sized bird, and probably a female.

Fig. 515. *Ninth cervical vertebra,* ventral aspect. Imperfect. Agrees exactly with that bone as found in the skeleton of a male *Centrocercus urophasianus* in the Coll. of the U. S. National Museum (No. 18346).

Fig. 516. Proximal end of a *radius.*

Fig. 517. Free extremity and portion of arch of the right *clavicle* of the *os furcula.* Mesial aspect. Male.

Plate XLII.

(This Plate is introduced in order to illustrate the study of "fragments" of fossils. The bones figured are all of natural size and all from Birds. They represent both sexes, various ages, and numerous families, genera and species. These fossil bones of birds are further intended to illustrate what is said in the text with respect to making reliable references.)

Fig. 518. Somewhat resembles an avian *ulna,* fragmentary and not identified. There are upwards of an hundred *ulnæ* in the Cope and Condon collections from the Oregon Desert Region, running all the way from fragmentary bits to specimens more or less fragmentary in character.

Figs. 519–523, 529–533, 535, 540–542, 547. The *humerus* of various species of birds. (See text.)

Figs. 524–528. Fragments of *pelves.*

Figs. 536–539, 543–545. *Carpo-metacarpi,* all more or less imperfect.

Figs. 546, 550–553. *Femora.* Figs. 550, 553 are apparently from the Ruddy Duck (*Erismatura jamaicensis*), as is also the humerus in Fig. 540.

Figs. 548, 549 and 554. *Tarso-metatarsi.* Anterior views and all subadult.

Plate XLIII.

(Devoted to the Fossil Mammals found in the collection of the American Museum of Natural History (Cope's). Referenees by Mr. J. W. Gidley of the Division of Vertebrate Palæontology (Mammals) of the United States National Museum. Reproductions of the photographs made direct from the specimens by the author. All natural size, and sexes undetermined.)

Figs. 555–561. Are referred to a canid,— "doubtless *Canis latrans.*" Fig. 555, *interparietal* bone; left lateral aspect. Includes the sagittal and part of the occipital crests. Fig. 556 from the *pelvis* near the acetabulum. Fig. 557, fragment of a *pelvis.* Fig. 558, an *ulna.* Figs. 559–561, *phalangeal bones.*

Fig. 562. *Incisor* tooth of a Camel (*Camelops*); anterior surface. The entire posterior part of the tooth is broken away,— a loss which cannot be seen in the Figure.

Figs. 563–579. Referred to large forms of Leporidæ (*Lepus*). Fig. 563, proximal portion of an *ulna.* Fig. 564, extremity of one of the long bones of a subadult individual exhibiting the epiphysis. Figs. 565 and 566 each represent an *os calcis* (*calcaneum*) of "a very large rabbit" (*Lepus*). Figs. 567–569 is the same bone belonging to smaller individuals. All are viewed on their superior surfaces. Figs. 570–574, 576–579 represent various long bones of the pes and manus. They are from different individuals of different ages and sexes, and very likely different species. For the most part they are viewed upon their dorsal aspects. Fig. 575 head of a *scapula* showing the glenoid cavity and the coracoid process with all the rest of the bone gone. (*Lepus*). These rabbits all belonged to the "Jack Rabbit" group.


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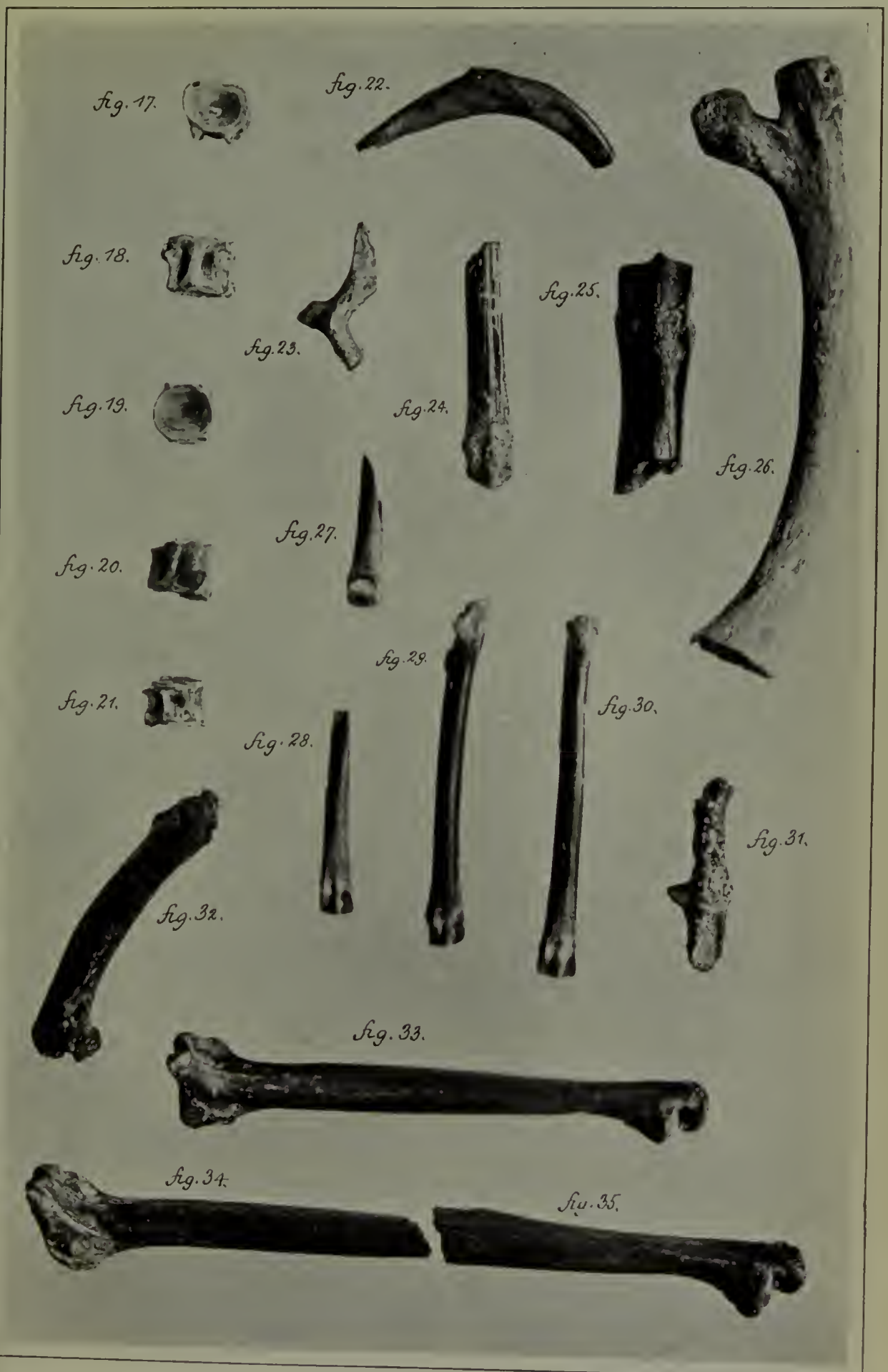
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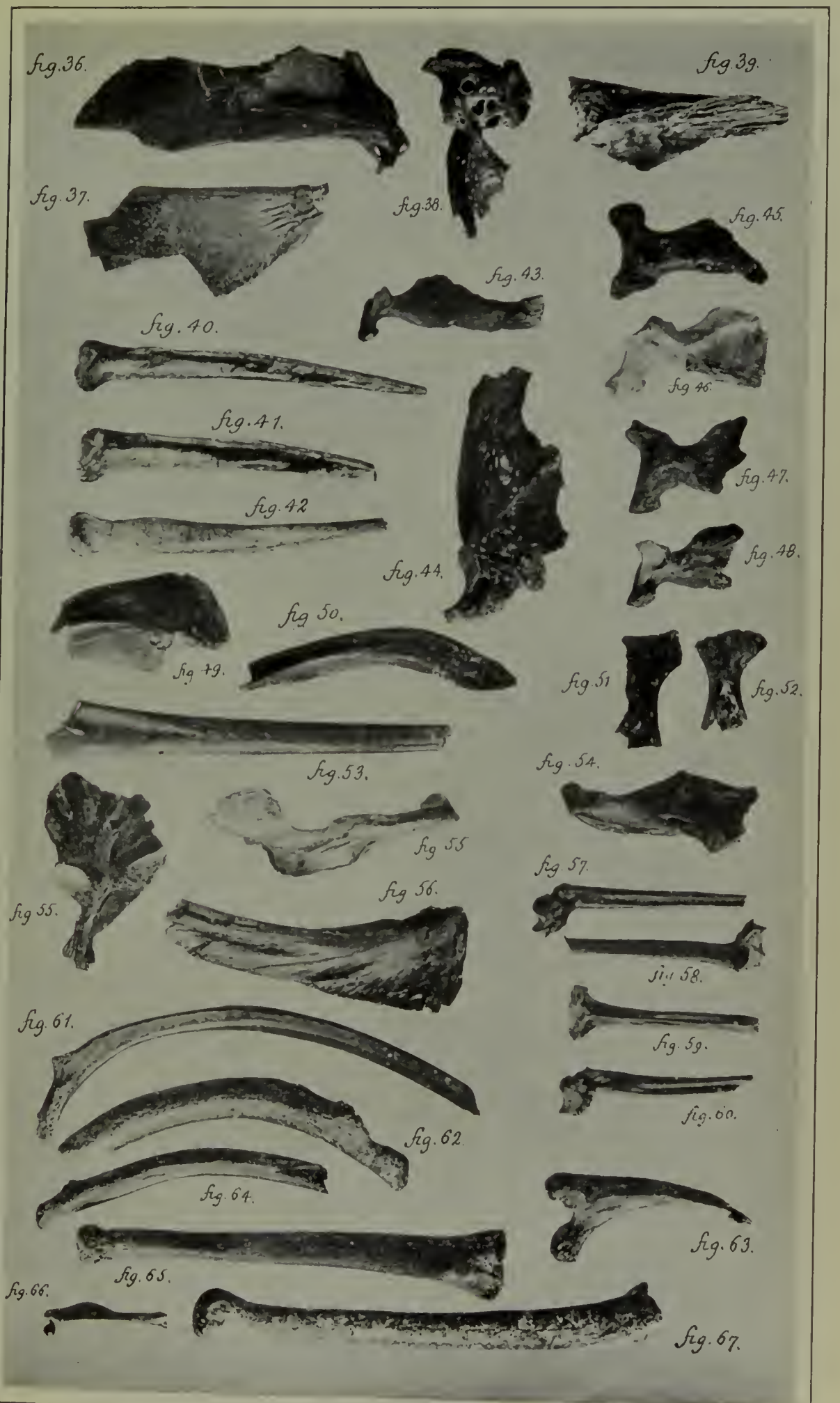
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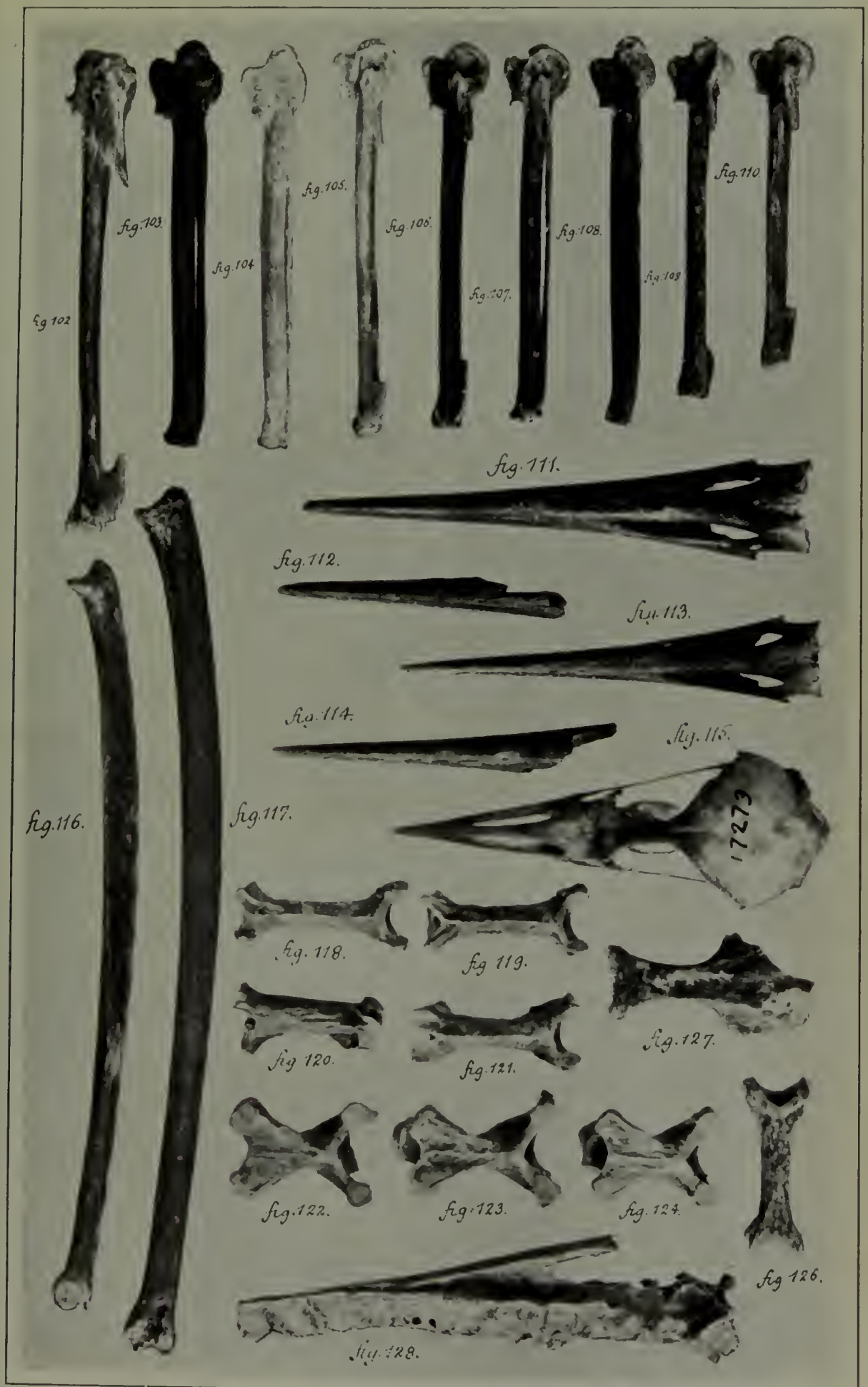
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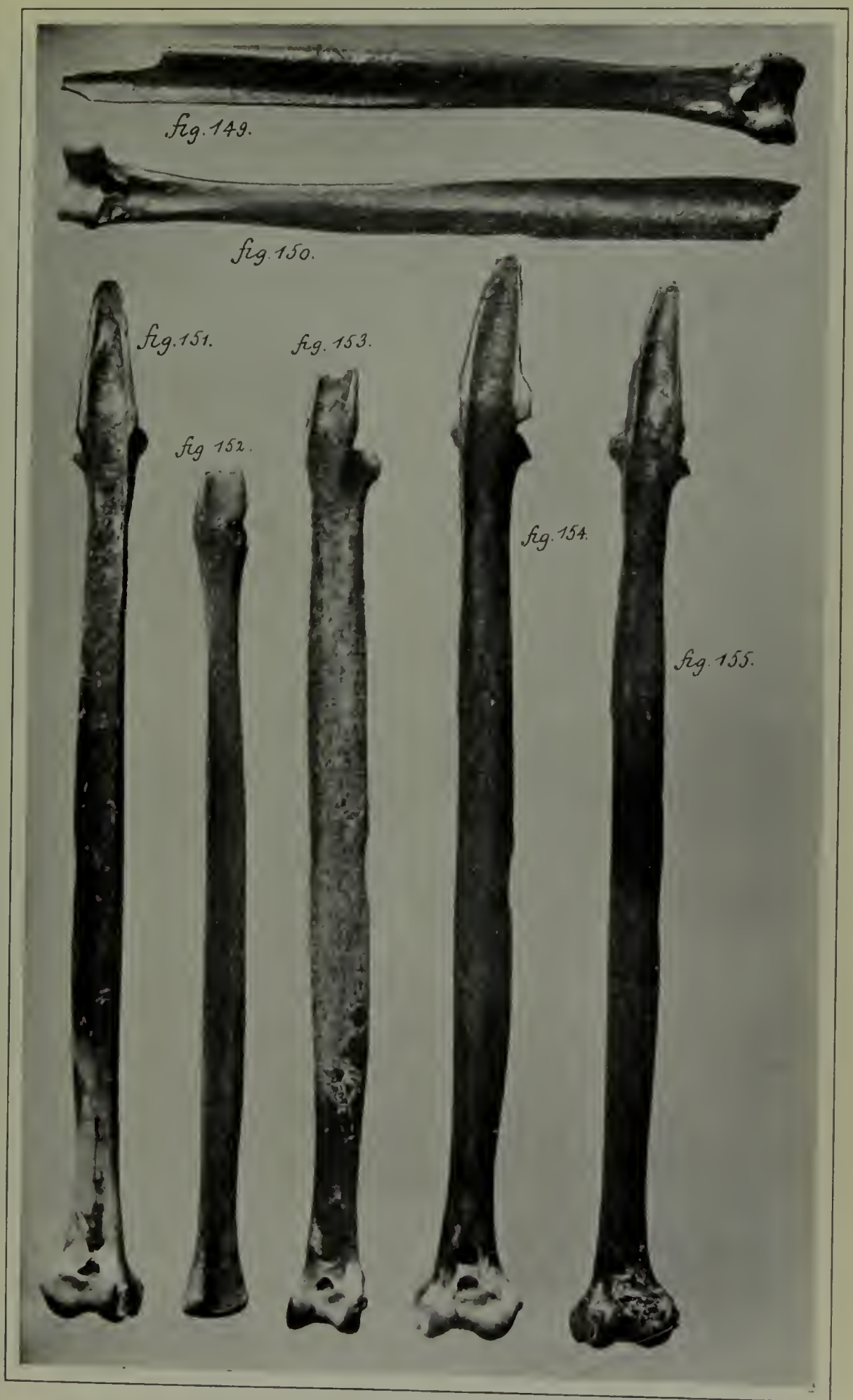
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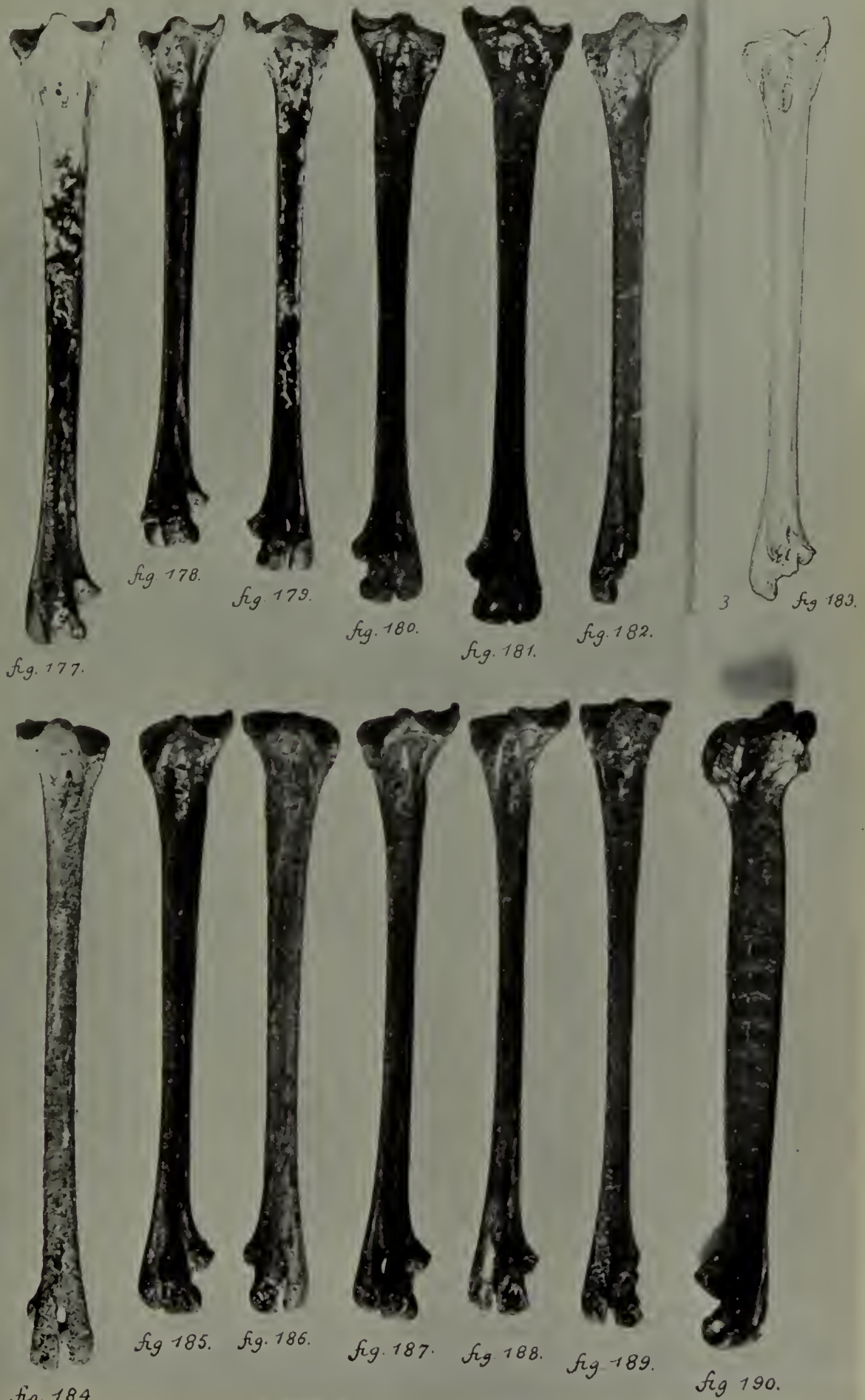
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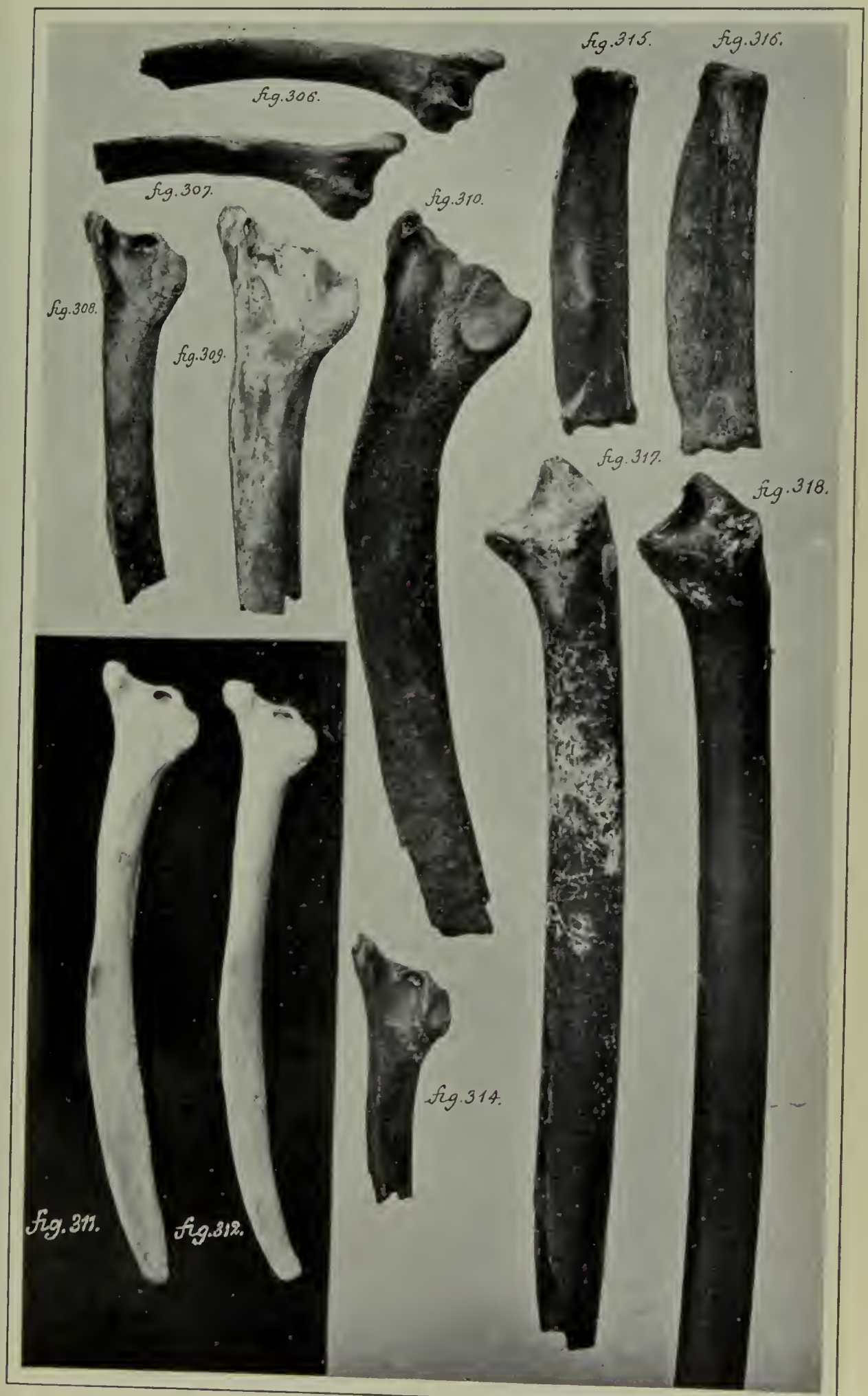
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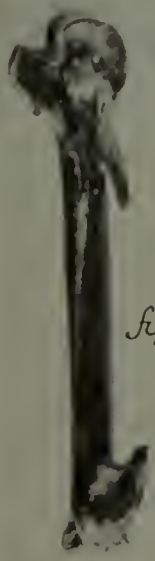

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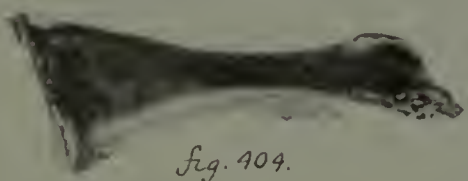

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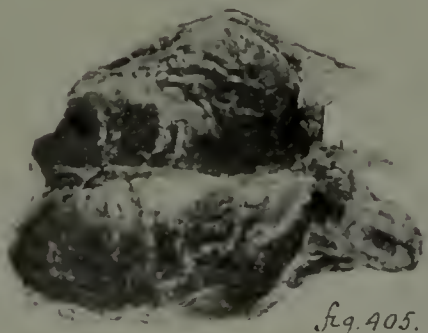

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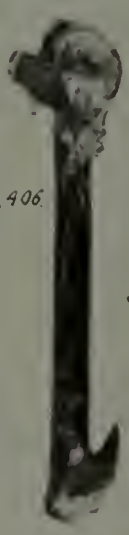

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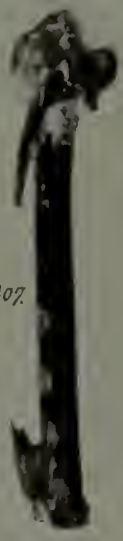

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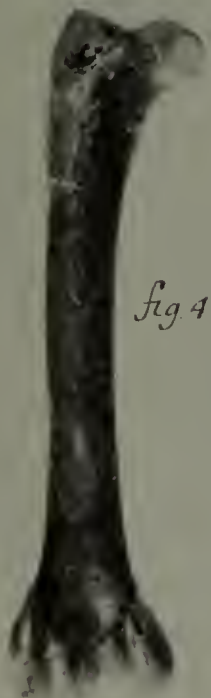

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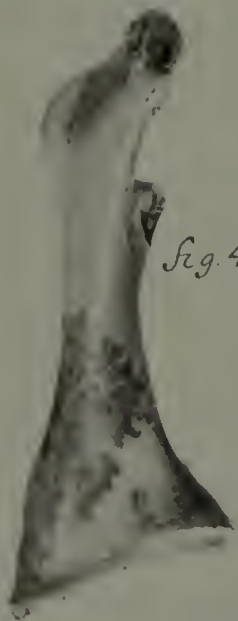

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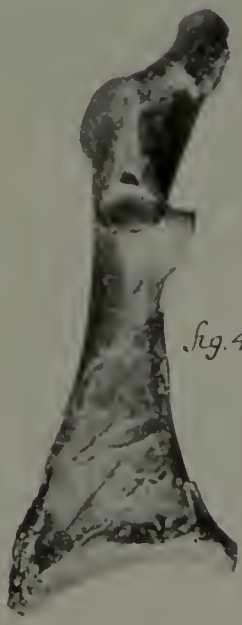

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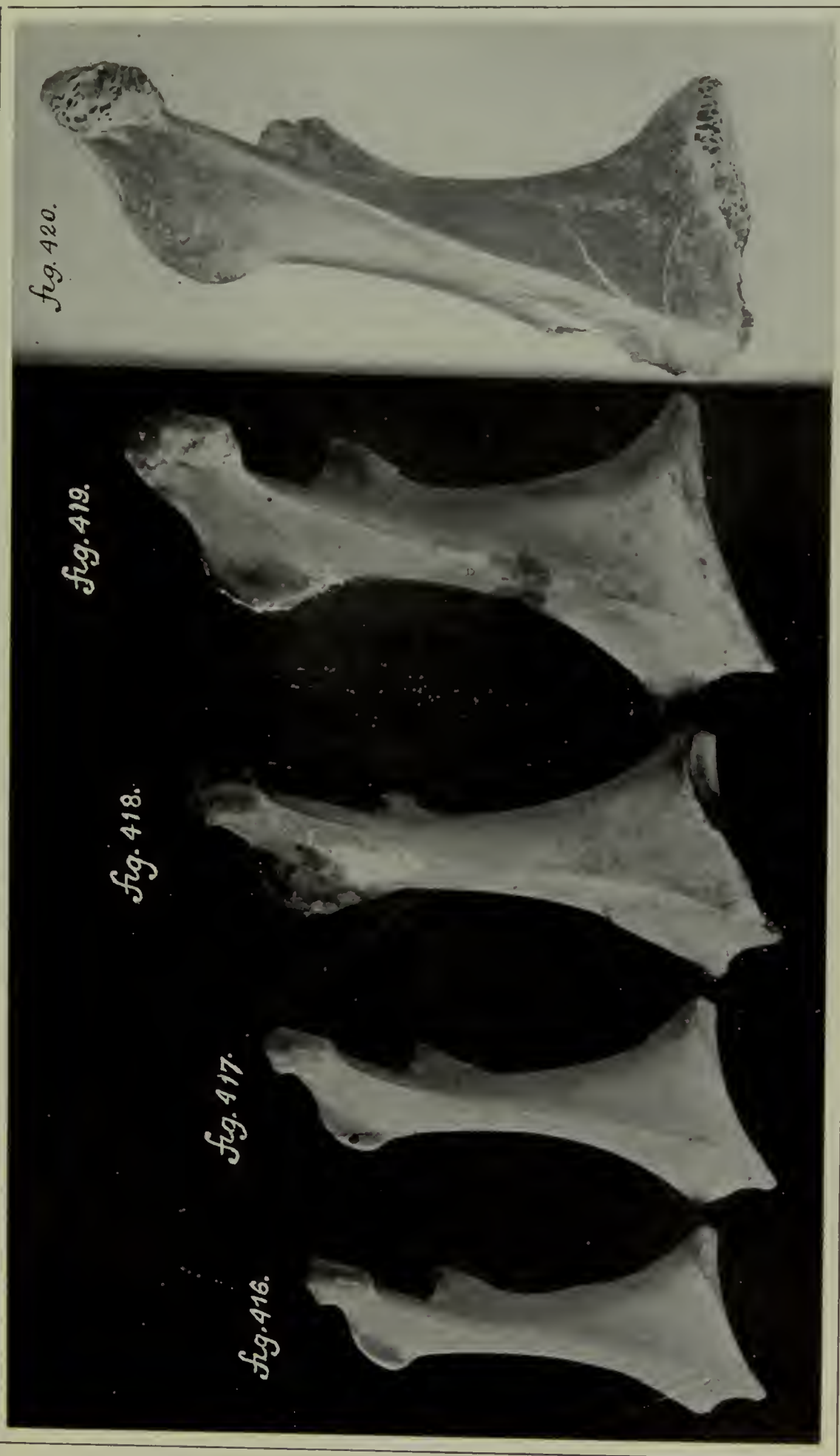
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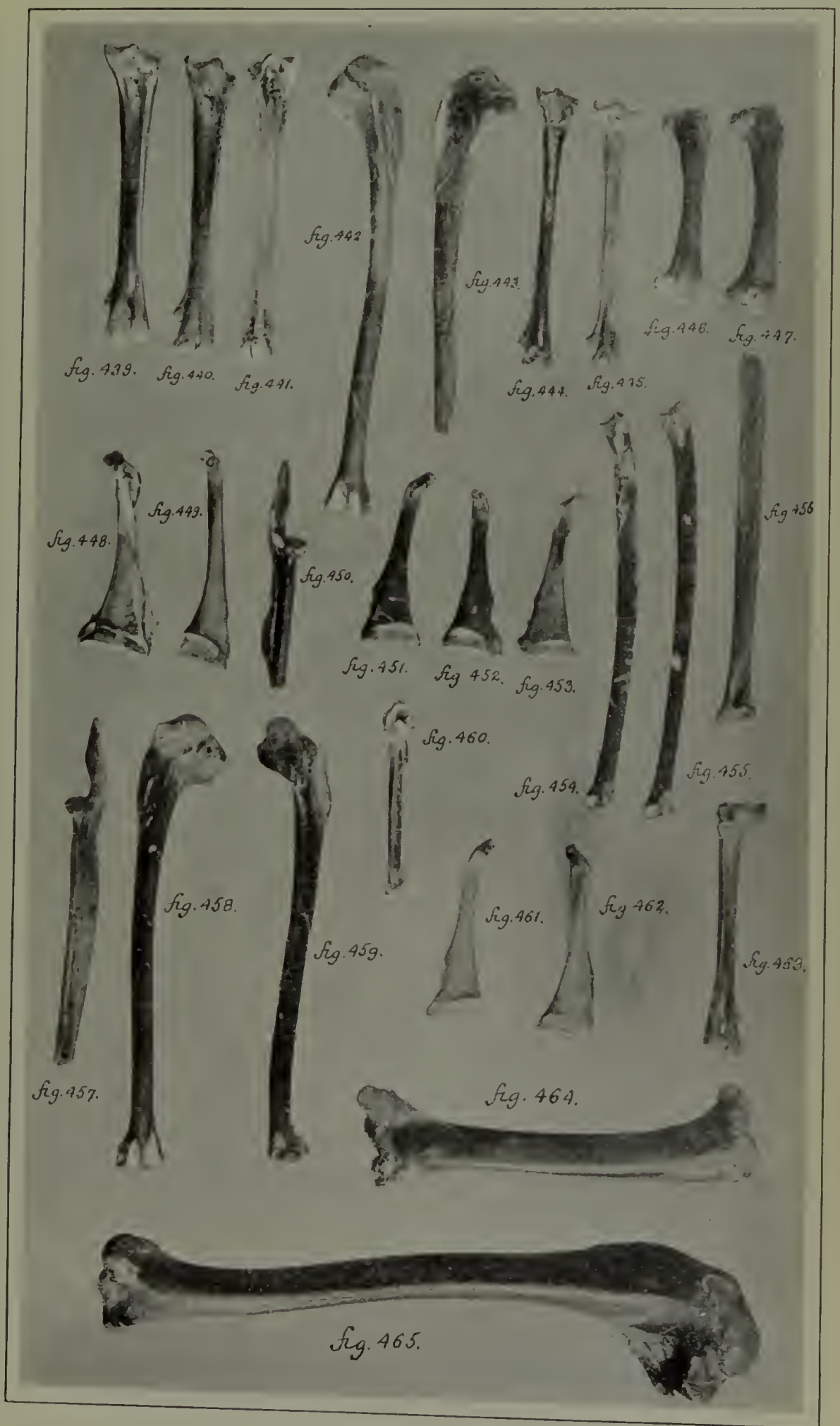
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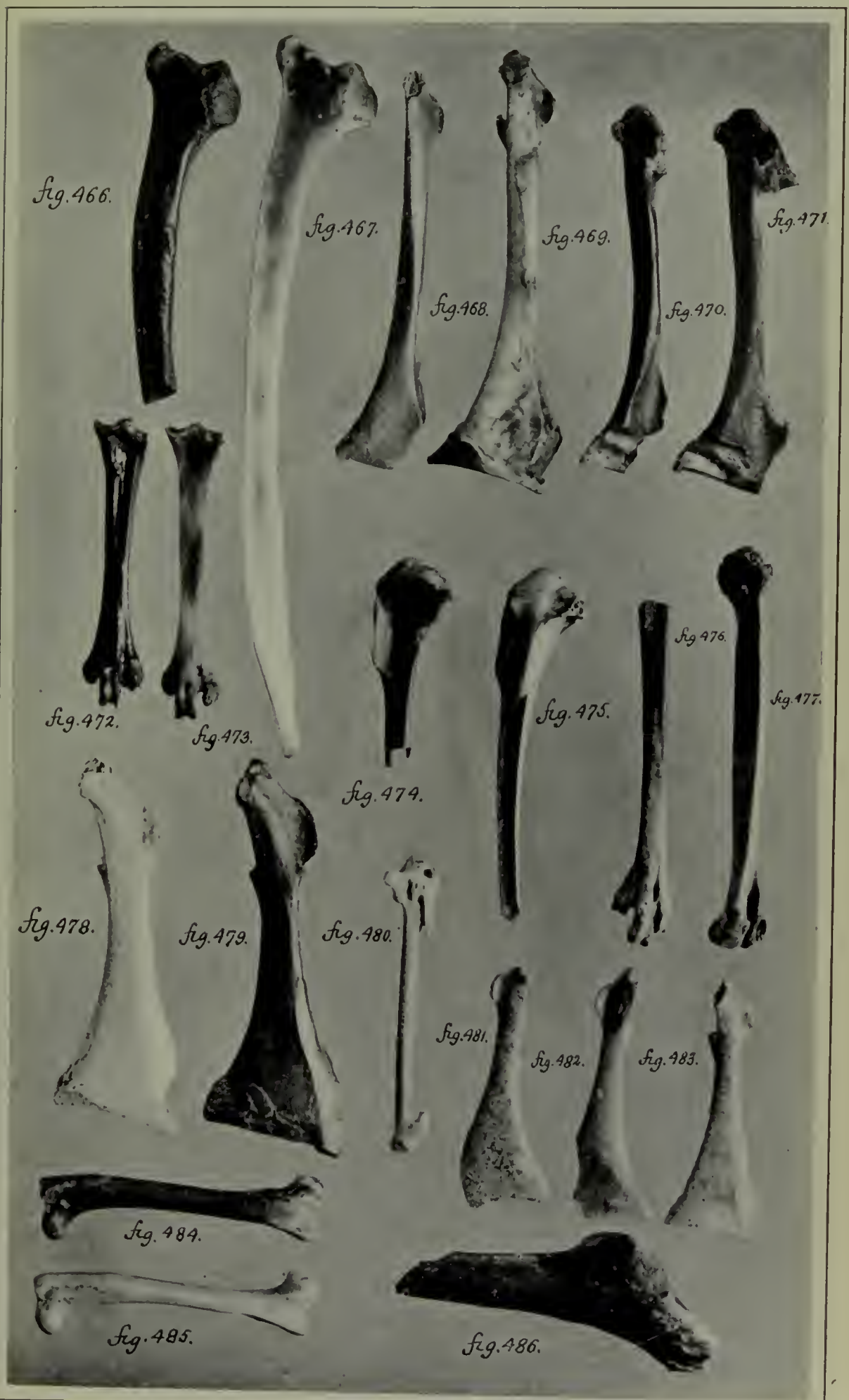
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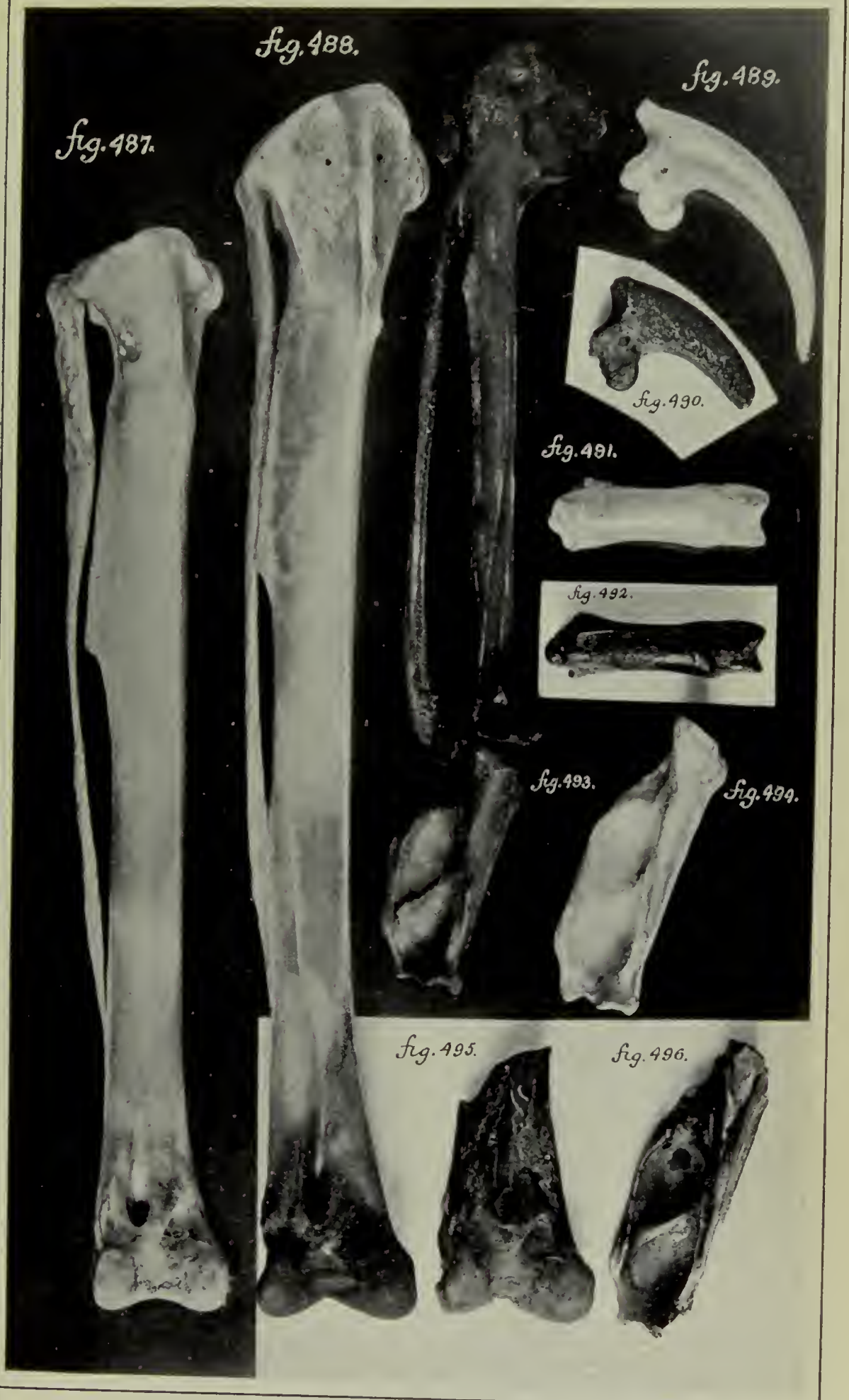
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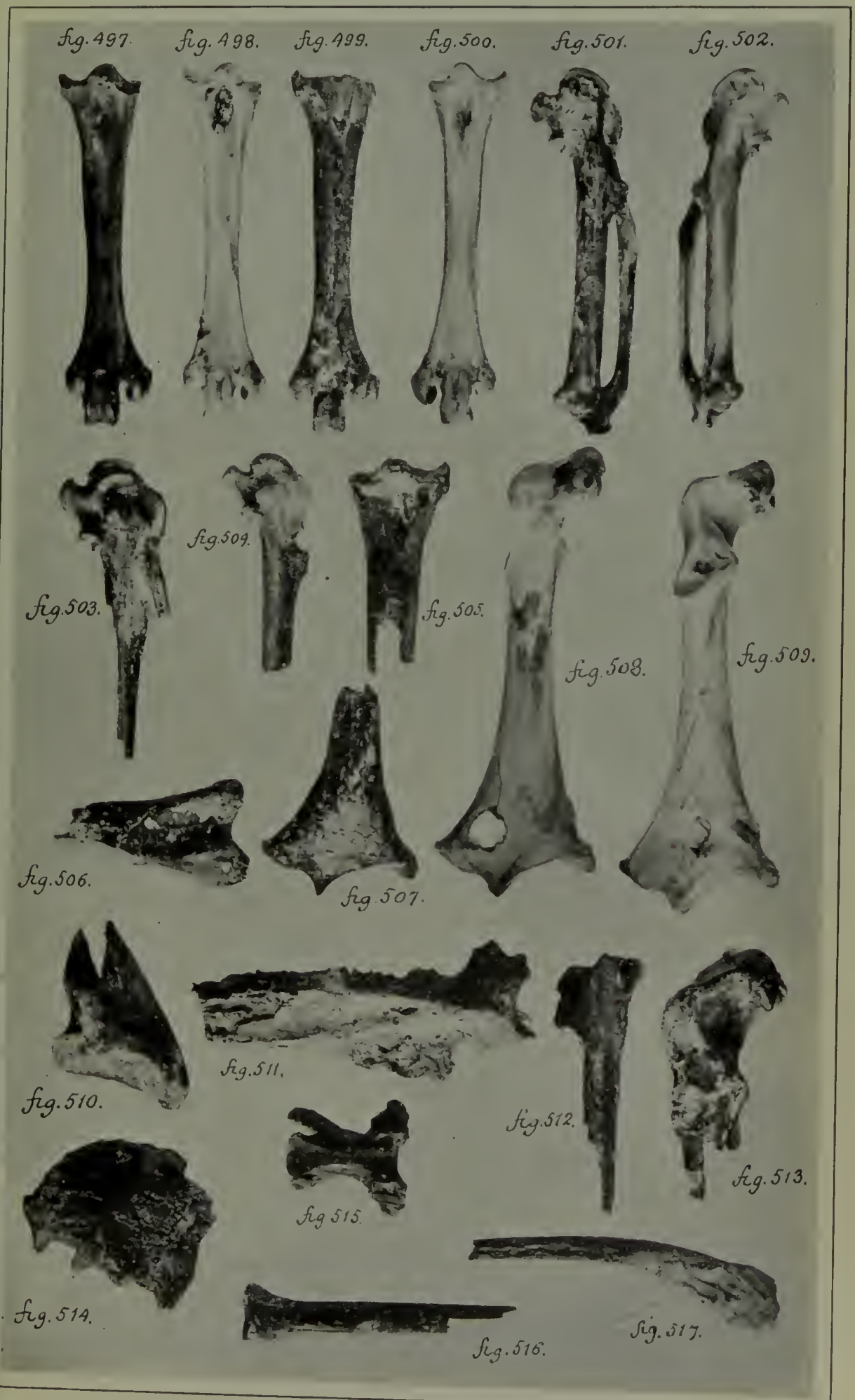
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